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Forest Service Missoula, Montana

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TO : Russell K. LeBarron DATE: December 20, 1950

FROM : G. M. DeJarnette, Forester

SUBJECT: S-CONTROL-Disease-White Pine Blister Rust

Attached is a copy of the revised "Specifications of Working Unit Analysis."

As you probably know, they are based on the original specifications designed for use in the Matthews-Hutchison study but have been revised to meet requirements for their present application in white pine management planning.

G. M. DeJarnette

Attachment

UNITED STATES DEPARTMENT OF AGRICULTURE

Forest Service
Missoula, Montana

S
CONTROL
Disease
Blister Rust

SPECIFICATIONS OF WORKING UNIT ANALYSIS

Revised November 1950

PART I - INTRODUCTION

Since blister rust control has become inseparably linked with all phases of white pine management in Region One, the system of analysis of working units developed during the Matthews-Hutchison study is proving to be a useful tool in preparing management plans for white pine lands. Not only does it contribute directly to the establishment of priorities among units for the distribution of BRC funds, but it likewise plays a very important part in prescribing the kind and type of other management practices to be applied within white pine areas.

One of the major recommendations coming from the study was that all management activities within white pine units should be so integrated as to "make it a white pine project." Plans and programs for control should be completely and tightly coordinated with other management plans and vice versa. Blister rust control should be one phase of the work, along with the burning, planting, weeding, fire control, and other measures required to grow white pine at low cost per thousand board feet.

The Working Unit

BRC working units now have been established on all the white pine forests although there may be need for some minor adjustments in boundaries, and perhaps a few additions and deletions. However, since the working unit is the basic instrument used in the analysis, a restatement of its definition at this point seems advisable. It is as follows:

> A working unit is a subdivision of the white pine zone which requires blister rust control and management as a unit. It is composed of one or a group of stands so situated topographically that the presence of ribes outside the boundaries of the working unit has a minimum effect on the white pine within the unit, and the benefits of ribes eradication within the unit are largely confined to it. It may be said that a working unit is that subdivision of the white pine zone that can be advantageously managed as a unit for the production of white pine at least cost under the handicap of blister rust. A working unit very often will consist of a single minor drainage. For purposes of comparison and analysis it is desirable to make the units as small as practicable and still meet the requirements stated above.

Fortunately, in most instances BRC working units and compartments have identical boundaries. This is very desirable because it promotes better coordination between BRC and other phases of white pine management. Wherever possible, working units and compartments should be made to coincide. A working unit may contain more than one complete compartment and vice versa.

One of the steps in the development of a BRC policy for national forest lands in the Inland Empire by Matthews and Hutchison was to obtain region-wide ratios of cost against yields for growing white pine under various size programs. Although this was accomplished by making calculations unit by unit, the ratio of cost to yield on individual units was of secondary importance. Nevertheless, by utilizing the data submitted, Matthews was able to form a general array of units according to priority on a cost per M basis. The

original data submitted were sufficiently accurate to group the units into those which were definitely or likely to be included in the programs and those which were definitely out. This was a great help in that it greatly reduced the number of units which we were subsequently to deal with and it gave us the first tentative alignment of units based on priority.

Future Use of the Unit Analysis

The use of the unit analysis has remarkable possibilities in the field of white pine management. For BRC alone it can be made the basis for an equitable distribution of funds among forests, for determining units of highest priority, and for prorating the control effort among units to get the most out of the moneys expended on each forest. It will encourage tighter coordination of all management practices within units. It also holds great promise in the field of planning. Specific and intensive plans can be developed with a greater assurance that properly timed follow-up treatments, both BRC and other, which are so vital to the efficiency of the job, can be effected. Furthermore, by means of the analysis, plans that are made can be adjusted more readily to meet the variations in appropriations, economic conditions, market demands and other modifying factors with considerably less loss of effectiveness than has been experienced in the past.

This is an ambitious role, but with proper application and care we have, through the use of the analysis, a means of alleviating at least some of the problems in white pine management and in BRC that have plagued us for two decades.

Analysis Specifications

The original specifications of working unit analysis were designed mainly to accomplish certain objectives in the Matthews-Hutchison study. They did, however, set the basic pattern for unit analysis procedure and, in general, the outline prepared by Matthews will be followed.

To fashion the analysis for its new role certain modifications are desirable. If we are to use the unit analysis as an instrument in white pine management planning, we must be realistic. Conditions set up for each unit for the purpose of analysis should, therefore, be those which will be the most probable and likely to exist. In the Matthews-Hutchison study all units were put on a more or less comparable basis by assuming that present mature white pine stands would all be cut in the first 20-year period. However, in considering individual units, this is not necessarily true.

We should show the most probable or logical time of cutting according to our best knowledge and judgment. Management plans, allowable cuts, long-term sales and proposed sales can be used as a basis for estimating year of cutting in many cases. In units where there are intermingled age classes, it may be extremely desirable for the sake of protection to delay the cutting of mature stands. It is not unlikely that in certain instances this pathological feature may outweigh pressures exerted by local economics or other timber management factors in determining the time of cutting. Likewise, it may be desirable,

or even necessary, to deviate from other prescribed treatments if there is sound reason for doing so.

Timing of Treatments

Probably one of the most important elements influencing the efficiency of a BRC program is the matter of proper timing. Now, with a tight integration of all white pine management activities within the unit, coordinated timing of all treatments is of profound importance. To make the unit analysis useful in management planning on white pine units the timing factor must be made a component part of the analysis.

The specification and forms for recording field data have been revised to incorporate this phase of the job.

PART II - COLLECTION OF DATA ON THE FORESTS

The first big job in the unit analysis is to collect the necessary data on the forests for analysis. Data to be collected are divided into six distinct portions.

1. Maps of working units.

2. Data necessary to estimate yields.

3. Data to determine costs of timber management and silvicultural practices specifically applied for growing and propagating white pine.

4. Record and estimates of supplemental funds.

5. Estimated future BRC costs in man-days.

6. Record of past BRC costs in man-days.

Each of these elements will be considered separately in the pages that follow.

Working Unit Maps

The following specifications will be used as a guide in preparing the map of each working unit:

A scale of 1 inch equals 1 mile will be used. Whenever possible, the maps should be drawn on standard 8-inch by 10½-inch sheets.

Show section lines, township and range which encompass the unit. The outside boundary of the unit should be drawn with ordinary drawing pencil and accuracy is not a factor providing area measurements of the unit can be obtained from other sources. If the area measurements are to be taken from this map the boundaries must be accurately drawn.

Streams should be shown in blue.

Ownership should be shown by a color legend using green for national forest land, blue for state, and yellow for all other, including public domain. Ownership boundaries may first be drawn in pencil and then with appropriate color the edges may be shaded. This is sufficient for ocular segregation.

Next, on units in which area classification has been completed, boundaries between classes should be drawn in red pencil. This divides the unit into areas of different classes. Each area should be given a letter designation and a BRC class symbol, i.e., A-3A, B-4A, etc. (See appendix for description of BRC area classes.)

For units on which BRC area classification has not been made, we must rely upon the Forest Survey data and any other local sources of information. Areas may be classified and given appropriate BRC area class symbols in the following

manner. In these units the area suitable for growing white pine should be segregated from the others by a red pencil line. Each of these types should be subdivided by red lines into areas wherever a difference in stocking, species, or age class exists, or where special timber management or silvicultural treatment is anticipated or desirable. When the break-down is complete, each individual area should be given a letter designation and the BRC class symbol which describes as nearly as possible the conditions that exist on the area.

In many units on which area classification has been made, certain areas designated by one class symbol may contain portions which differ substantially in stocking, age class (20 years or more), or composition of stand. Also special timber management or silvicultural treatment may be anticipated only on a part of the area. Should this be the case, the area should be subdivided by a broken red line and the portions be given designations such as A-3A, and A'-3A. For analysis purposes they will be treated as separate areas. White pine areas of site IV or poorer should be separated from areas of better sites if possible.

In units where it is not necessary to extend ribes eradication work to the unit boundary, because of the amount or location of the vulnerable white pine stands, the extent of the work into the buffer strip should be indicated by a dashed line made with ordinary lead pencil.

The location of all disease-stocking survey strips should be indicated on the map. This may be done by drawing a line with orange crayon at the proper location. The year in which each strip was run should also be shown.

The unit number and name and name of the forest should appear on the map sheet.

The next step is to tabulate the acres in each area in each unit. Form M-1056-R1 is provided for this purpose. The gross acres in each area will be tabulated by the three ownership classes. Since gross acres contain stream type and may contain meadowland or some other nontimber-producing land, deductions should be made accordingly. These net acres which represent actual timber growing land will be tabulated in the right-hand columns of the sheet. Where stream type acres are known, the actual figures may be used. In unworked units an average percent deduction may be applied. This percent may vary by forests and perhaps by drainages.

Data Necessary to Estimate Yield

With the gradual reduction in size of the BRC program in the late 1930's and early 1940's, BRC men from both the Bureau of Entomology and the Forest Service felt the need for a more careful scrutiny of the white pine work areas so that the limited funds would be spent on areas having the greatest potential white pine values. This led to the development of the pine-count surveys and the system of area classification. After it became apparent that the 1941 "wave year" had resulted in extensive rust damage throughout the region, it was obvious that resurvey of immature pine stands for rust damage was necessary.

The Matthews-Hutchison study, likewise, showed clearly the need for more adequate information on damage, stocking and composition in white pine stands. As a result, a system of intensive survey to determine stocking and damage was devised. Methods of coordinating and utilizing the survey data for estimating potential white pine volumes were also developed. Credit for making the damage-stocking survey system suitable for use in unit analyses and management planning should go to R. T. Bingham and the many others who expended very much time and effort towards its development.

The system of collecting and summarizing damage-stocking data is described in detail in the Stocking-Rust Damage Survey Manual put out by the Bureau of Entomology. Yield tables based on those originally prepared by R. K. LeBarron and C. A. Wellner have been revised so that estimates of expected white pine yields can be made through use of the summarized survey data. Sets of these tables are included in appendix.

To determine yields we need to know the present age, composition and stocking of the stand and the site quality of the area. Form M-1057-R1 entitled "Area Description" has been designed to record this information for use in the unit analysis. Following are specifications for recording the data on this form.

Data on each area within the unit will be recorded separately on this form.

A single white pine area may involve portions with different site quality. The percentage of the total area represented by each site quality will be shown in the upper left-hand corner of the form.

Data on stocking obtained by surveys are summarized by areas on form BRC-32 (see page 15 of the Stocking-Rust Damage Survey Manual). The figure to be used here appears in the "Total" column under item "N." This is the total percent of quadrat stocking for all species after the mark-up factor for age class has been applied. The revised yield tables are based on percent stocking and are broken down by 10 percent stocking classes. The total figure in item "N" on form BRC-32 raised or lowered to the nearest ten should appear on the Area Description form in the space marked "Stocking Class."

(The stocking data originally submitted for the Matthews-Hutchison study were in terms of three broad stocking classes - well, medium and poor. Original yield tables were in terms of these three classes. The damage-stocking survey system, however, provides a way of measuring the degree of stocking with considerable accuracy. Consequently, a further break-down of the yield tables by stocking classes was felt highly desirable.

For units and areas on which no damage-stocking surveys have been run, we must rely on the original method and tables in estimating yields.

The correlation between the stocking classes shown in percent and those of the Forest Survey is as follows. Areas in the 10 percent to 30 percent stocking classes are considered poorly stocked; 40 percent to 60 percent, medium; and 70 percent plus, well stocked.)

Figures for composition will be taken directly from item "O" on form BRC-32. These figures represent the percent of the total stocked quadrats after mark-up occupied by each tree species. When showing percentage of composition for mixed species individual species percentages should be combined into the following groups:

1. Grand fir.

2. Larch, Douglas-fir, spruce (and alpine fir).

3. Hemlock, cedar.

4. Lodgepole pine, yellow pine.

The reason for this particular grouping will be explained later. List the predominate group first.

Percent of infection and damage asked for on form M-1057-R1 may be obtained directly from form BRC-32 for each area (items "$\frac{D}{E}$" and "$\frac{H}{E}$" respectively).

In estimating future damage use Bingham's curve and table for submaintenance areas. We are particularly interested in the extent of damage to the stand that will occur by the time it reaches 80 years of age. Expected damage to white pine stands 60 years of age and older may be obtained directly from the table. Damage to stands 50 years of age may be derived from Bingham's curve in the following manner. Select the point on the curve corresponding to the present percent of damage. This will give the corresponding number of years, theoretically, the rust has been present in the stand. Add to this the number of years the stand has yet to go to reach 80, i.e., 30. The extent of damage indicated by the curve at that point will be sufficiently close for our use. This should be recorded under "Remarks" in the lower left-hand corner of the Area Description form, as for example: "98 percent at 80 years if no more BRC work is done."

According to the curve, any white pine stand 40 years of age or younger in submaintenance status and where rust is already established will experience virtually complete damage by its 80th year.

If the degree of control has been reached where less damage is expected, your best estimate should be entered and a note to that effect made under "Remarks."

As a general rule, yields of white pine will be calculated in the analysis for areas of class 1 and 2 only. If, however, areas of class 3, 3A or 3B are so located with respect to classes 1 and 2 that protection will be afforded to the pine within them, or if the staffman believes that the amount of additional BRC work to protect the pine in such areas is commensurate with the pine values involved, yields should and will be calculated. It is very important that a definite statement to this effect be made on the Area Description form.

Data to Determine Costs of Other Timber Management and Silvicultural Practices

The costs of those silvicultural and management practices specifically applied for "growing and propagating" white pine, herein referred to as "other costs," will include the costs of only those treatments which are done primarily for establishment of white pine or those which directly effect an increase in the potential white pine volume.

True, fire control and insect control prevent a loss in white pine volume, forest improvements may enhance utilization and certain silvicultural treatments such as pruning may increase the value per unit of volume of white pine products, but none of these measures contributes directly to the establishment of white pine or to increasing its potential volume.

For this part of the analysis, we are concerned only with those treatments that will occur in the next 20 years.

Conditions set up for each unit should be those which will be the most probable and likely to exist. This in no sense means that we should forsake proper management and silvicultural practices wherever such management is possible, but we must beware of becoming too academic in our approach. This means that we will analyze the unit on the basis of "present management" under the existing ownership pattern or that which we expect will exist at the time the treatment will be applied. Unless conditions peculiar to the unit prescribe otherwise, follow the specifications under "present management" as described by Matthews. These are as follows:

> Present Management assumes that national forest lands site III and better will receive the blister rust control, burning, planting, and weeding treatments needed to produce the maximum amount of white pine. It is assumed that white pine lands of other ownerships will not be so managed. In areas of mixed ownership the practicability of giving the national forest land special treatment must be considered. If the position of national forest land with reference to other land makes such management impractical, treatments will be much the same as on other lands. Present management of other than national forest land assumes that the white pine will be cut when 90 years of age (80 plus 10) provided there is 25 percent or more of white pine and stands are well or medium stocked. The remainder of the stand would be cut when 130 years old. It is assumed that in most cases present cutting practices on other lands will prevent the establishment of white pine.

There may be occasion to analyze units of mixed ownership on the basis of "high" management. Specifications are as follows:

> High Management assumes that all white pine lands site III and better of all ownerships will be given the blister rust control, burning, planting, weeding and harvesting treatments needed to produce the maximum amount of white pine in perpetuity. Estimates on this basis not only show the intrinsic capacity of the unit but when contrasted with "present management" they show the extent to which the lack of intensive management due to ownership can reduce yields of white pine and increase costs.

Present and high management will be the same on units of all national forest land.

On form M-1057-R1 under the heading "Timber Management Data" the treatments for each area that are most likely to occur according to the type of management should be indicated. Care should be taken to present enough information so that anyone completing or reviewing the analysis will have a full understanding of the proposed treatments.

In order to insert the element of timing in planning and estimating costs of silvicultural treatment, form M-1075-R1, entitled "Other Costs - Supplemental Funds" has been designed. Here space has been provided for showing the proposed year of accomplishing the treatment as well as the estimated man-days required. This should be carefully coordinated with the data shown on the Area Description sheet and at all times with the BRC information shown on the "Future BRC Costs" form. The timing of treatments shown on form M-1075-R1 should be based on the most practical and logical sequence of events.

Once the time of the beginning treatment of a series has been established, the time of subsequent treatments should be set to take the fullest advantage of ecological and pathological factors. The time and type of cutting on national forest lands will set the pattern for the type and timing of successive treatments including BRC on these lands.

The basis upon which the date of cuttings on national forest lands is determined may vary from well crystalized plans to just a guess. Such elements as accessibility, species of timber, market conditions and trends, management plans, long-term sales and proposed sales may be indicators of the time of cutting. Estimates for cuttings on private lands may be even more difficult to determine. The staffman should take account of all factors at hand and set the date of cutting according to his very best judgment.

On national forest lands where cutting is not involved but where treatments such as prescribed burning, planting, fill-in planting, etc., are desirable, several points should be considered. If the degree of rust control in the unit is such that the treatment should be delayed, the time of treatment must be coordinated closely with ribes eradication plans. Likewise, the timing of treatment on certain areas may be dependent upon the relationship to adjacent areas. Also, timing may be delayed to await completion of preliminary preparations.

If however, there are no physical, pathological or administrative reasons for delaying treatment, the time of treatment should be set for next season. This procedure may appear arbitrary or academic on the surface, but it should be remembered that we are still in the process of comparing units, weighing one against the other; and even though, for monetary reasons, we may have to delay or even forego such treatments, we do need to know how the unit will compare with others under our present program and where it fits in in the several proposed programs.

Man-day estimates for burning, planting and weeding may be made from cost data shown in the table "Rates for Cost Estimates" (see appendix) When estimates

have been made for all areas set up for treatment in the unit, a summary of "other costs" by years may be made in the lower portion of form M-1075-R1.

On some units there may be alternative types of treatments that could be made. It may be desirable to set up more than one set of conditions and go through the analysis to find out which will be the best to prescribe. This will require separate sets of Area Description sheets, forms M-1075-R1, and Future BRC Cost forms.

For the purpose of this analysis, burning, planting and weeding costs will include only those required for the treating of and re-establishing white pine on white pine lands of site III or better. It is generally agreed that the increased volume of white pine produced by weeding and planting treatments on areas of site IV quality or poorer does not justify the cost of such treatments. In actual practice, however, it may be administratively impractical to conform to this rule under certain conditions. Strictly for the purpose of analysis we will assume that such treatments will be limited to areas of site III or better. The cost of burning and planting to other species of site IV and non-white pine lands should not be included in "other costs" chargeable against white pine. This is true whether the process of treating the non-white pine land is done in conjunction with similar treatments on white pine lands or done as a separate project.

If, however, non-white pine land in a unit is burned primarily as a means of ribes eradication, the cost of burning may be justifiably charged against white pine and included as part of the future BRC cost estimate.

Supplemental Funds

Under any proposed program the element of cost will limit the number of units that can be included. Likewise, the total board feet of white pine produced under any program will be greatly influenced by how fully we are able to apply the prescribed management practices and treatments within the selected units.

Regularly appropriated BRC funds cannot be used for anything except those activities which directly affect the control of the rust. Whenever legally and physically possible, slash and K-V money are to be used to supplant regular P&M money for reforestation or other necessary TSI measures. At present no regular funds are being appropriated for stand improvement. It is, therefore, essential that we utilize to the fullest extent funds collectible from timber sales for such use as a supplement to regular appropriations.

We know that even at best slash disposal and K-V funds will fall far short of what is required to meet the management needs on all white pine units under any program. We would be in a much better position, however, to ask for more regular P&M funds for silvicultural treatments if we can present a plan which shows that slash and K-V funds are being used to the fullest extent and that the additional funds requested would materially increase the effectiveness of total expenditures in terms of a lower over-all cost per thousand.

On almost every white pine forest in the region money has already been or is being collected from timber sales on white pine land for just such management use. Further collections are likewise being planned. On some units where partial cuttings are planned K-V funds are to be collected primarily for the suppression of ribes along roads and other openings created by the cutting operation.

Since the collection and use of such funds vitally affect the drain on regular P&M and BRC appropriations, a record or estimate of such collections is definitely an active element in unit analysis.

Space has been provided on form M-1075-R1 for recording estimates of slash disposal and K-V supplemental funds. Since in the analysis all costs are in terms of effective man-days, entries made for supplemental funds should be shown in equivalent man-days. For the present we have chosen $20 as an average cost per effective man-day. Making estimates of supplemental funds in terms of man-days should not be difficult. Although slash and K-V funds are collected on the basis of dollars and cents per thousand board feet, estimates of the amount of money to be collected are based on the need for accomplishing certain jobs which in themselves represent man-days. The authorized maximum for K-V funds collectible per acre is based on the average cost of planting over a 3-year period. Since in the analysis we have assumed that 2 man-days per acre is the cost of planting, we will use this as the maximum amount collectible in making K-V estimates, even though this is more than the present authorized maximum.

The procedure in recording data on form M-1075-R1 can best be explained through examples. Three sample areas have been chosen and the conditions are as follows:

Area No. 1

Description: The area consists of 400 acres supporting a medium stocking of 60-year-old white pine and mixed pole with patches and stringers of 160-year-old mature. Survey shows 40 percent stocked quadrats in pole and 10 M per acre white pine and mixed mature. Area classified as a 2 area, designated as A-2.

Proposed Treatments: A partial cut is planned, averaging 3.75 M per acre including roads and other improvements. Total volume cut is 400 x 3.75 or 1,500 M. Cutting operations will be completed in 1950.

Costs: Ribes eradication by spraying along roads and other openings will be the only item of cost. About 15 percent of the 400 acres (60 acres) will need treatment. It is estimated that two workings will be required, one in 1954 and the second in 1957. The total cost is estimated to be 1.25 man-days including chemical for each acre treated, 1.25 x 60 or 75 man-days, 40 for first working and 35 for the second.

Supplemental Funds: Slash money collected will be used for piling and burning and since this does not contribute toward white pine production, this fund will not be considered. K-V will be collected to cover BRC costs. 75 man-days at $20 per man-day equals $1,500. A collection of $1.00 per M will cover costs.

Area No. 2

Description: This area, 250 acres in size, supports a residual stand of 200+ mixed mature, averaging 20 M per acre grand fir, Douglas-fir, larch and cedar. Total volume is 5,000 M. Area classified as B-5a.

Proposed Treatments: Clear-cutting of the stand, followed by prescribed burning and planting is planned. The burning will be completed by 1954. The bulk of the ribes will be eradicated by summer of 1959, and planting will be done that fall. Ribes eradication will be done by broadcast spraying.

Costs: The standard cost rates listed under "Rates of Cost Estimates" will be used. BRC costs are calculated at 0.8 man-days per acre. 0.8 x 250 equals 200 man-days. 120 man-days will be expended on first working in 1957, 60 more in 1959, leaving 20 man-days for inspection and mop-up in 1962. Burning costs at the rate of 1.3 man-days per acre will amount to 325 man-days. Planting at 2 man-days per acre will cost 500 man-days.

Supplemental Funds: The accepted bid for the timber was made under the following provisions: Slash money collectible was set to cover burning costs. 325 man-days at $20 equals $6,500. $1.30 per M will cover burning costs. Stumpage receipts including K-V will be $2.00 per M. Since a minimum of $1.00 per M goes to the Treasury, the maximum of $1.00 per M or $5,000 total will be collected to apply on planting costs. $5,000 at $20 per man-day will pay for 250 man-days on planting. The remaining man-days on planting will be financed from P&M.

Area No. 3

Description: This area is comprised of 600 acres of 130-year-old white pine and mixed. An intermediate cutting was made in 1945, at which time 50 percent of the volume, mostly mixed, was removed. Since the remaining stand is 65 percent white pine, the major value still remains. Volume of present stand averages 24 M per acre. Area is classified as C-5.

Proposed Treatments: The second cut is planned for 1957. All volume except a few white pine seed trees will be removed. A weeding job is planned for 1965.

Costs: One BRC working has been done after the 1945 cutting. Another working requiring 160 man-days is planned for 1953. After 1957 cutting, two more workings are planned, 100 man-days in 1960 and 60 man-days in 1963. Weeding at 2 man-days per acre will require a total of 1,200 man-days in 1965.

Supplemental Funds: K-V funds were collected in 1945 for BRC work. Enough balance remains to finance the 160 man-days in 1953. The maximum of $40 per acre will be collected in 1957 to pay for the 1,200 man-days on weeding in 1965.

Entries made on form M-1075-R1 are as follows:

Area A-2

BRC: Total man-days 75; 40 man-days in 1954 and 35 in 1957. The date shown in upper part of form is 1954 since this is when the BRC work is started. All BRC will be paid from supplemental funds.

Area B-5A

Burning: 325 man-days in 1954 paid from supplemental funds (slash).

Planting: 500 man-days in 1959, 250 man-days from K-V funds and 250 from P&M.

BRC: 200 man-days starting in 1957. 120 in 1957, 60 in 1959, and 20 in 1962, all to be paid from BRC regular appropriations.

Area C-5

BRC: Total man-days 320. 160 man-days in 1953 paid from K-V, 100 in 1960 and 60 in 1963 paid from regular funds.

Weeding: 1,200 man-days in 1965 all to be paid from K-V funds collected.

Summary by Years

Year	Area	Man-days	Treatment	Fund
1953	C-5	160	BRC	Supp.
1954	A-2	40	BRC	Supp.
	B-5A	325	Burning	Supp.
1957	A-2	35	BRC	Supp.
	B-5A	120	BRC	P&M
1959	B-5A	60	BRC	P&M
	B-5A	250	Planting	Supp.
	B-5A	250	Planting	P&M
1960	C-5	100	BRC	P&M
1962	B-5A	20	BRC	P&M
1963	C-5	60	BRC	P&M
1965	C-5	1,200	Weeding	Supp.

There are two important points to keep in mind when recording data on form M-1075-R1. The equivalent man-days entered under supplemental funds should be only those which directly affect the establishment, increase in volume, or protection from rust of white pine. Secondly, the BRC costs shown on this form whether paid by K-V or regular funds should be only those which are incurred as a result of the cutting from which supplemental funds are collected. For example, in area A-2 there may be man-days spent on ribes eradication in the pole stand which bear no relation to the cutting disturbance. These are not shown on form M-1075-R1.

S Sample M-1075-R1

CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
OTHER COSTS -- SUPPLEMENTAL FUNDS
(First 20-Year Period)

Operation Kaniksu

By D.J.M. Date 12-6-49

Working unit: No. 82 Name Bear Creek

Management Level
Present ☑ High ☐

Area and class	Type of treatment	Man-days required	Year of treatment	Supplemental funds collectible in equivalent man-days (Use $20 per man-day)**			Man-days to be paid from P&M	
				Slash	K-V			
A-2	Burn							
	Plant							
	Weed							
	BRC	75	1954		75			
B-5A	Burn	325	1954	325				
	Plant	500	1959		250		250	
	Weed							
	BRC	200	1957				200	
C-5	Burn							
	Plant							
	Weed	1,200	1965		1,200			
	BRC	320	1953		160		160	
	Burn							
	Plant							
	Weed							
	BRC							
	Burn							
	Plant							
	Weed							
	BRC							
	Burn							
	Plant							
	Weed							
	BRC							
Totals	Other	2,025		325	1,450		250	
	BRC	595			235		360	

Summary by Years

Year	Burning		Planting		Weeding		BRC	
	Supp	P&M	Supp	P&M	Supp	P&M	Supp	P&M
1953							160	
1954	325						40	
1957							35	120
1959			250	250				60
1960								100
1962								20
1963								60
1965					1,200			

**Show equivalent man-days for only those funds that will be used directly for white pine production (i.e., prescribed burning, ground preparation, planting, weeding and for control of blister rust). Funds to be used for other purposes such as piling and burning of slash should not be included. In estimating amounts collectible from future cuttings, show maximum amount collectible that will be used for purposes described above.

BRC man-days paid from K-V funds should, of course, be included in the Future BRC Cost estimates on form M-1059-R1. As described under specifications for future BRC costs after the summary of BRC costs by years is completed, an additional entry should be made on the bottom of form M-1059-R1 showing the BRC man-days that will be paid from supplemental funds for each respective year.

Future BRC Costs

The two most important factors entering into the analysis are the estimates of future BRC costs and the data necessary to estimate white pine yields. The ratio of cost against yield is the fundamental basis for determining priorities. This section, therefore, is of major importance.

For the Matthews-Hutchison study the accuracy of the estimated BRC costs needed only to be consistent with the accuracy of the data submitted for computing yields. By means of the disease-stocking survey, however, we have greatly increased the accuracy of our yield estimates. We must, therefore, make every attempt to meet this degree of accuracy in estimating future BRC costs.

We not only need to scrutinize more carefully the estimates of future BRC costs but we must also consider the timing of the BRC workings on individual areas and units.

Before setting up specifications for recording estimates of future BRC man-day costs, let us briefly review certain accepted guides which are followed in estimating man-day requirements. Past experience has shown that on stabilized areas of reproduction and pole, satisfactory control standards can be met after three good effective workings. On some areas, of course, this can be accomplished after two or even one working. On nearly any stabilized area portions will be on maintenance after the first working, more after the second, etc. As a rough rule of thumb, one-third will meet maintenance standards after first working and two-thirds after the second. This varies, of course, with ecological conditions. For proper timing, workings are usually spaced 2 to 4 years apart to allow for any ribes regeneration that may result from the previous disturbance.

In stream type and on areas disturbed by cuttings, portions may require as many as four workings. The use of chemicals on cut-over and rehabilitated areas may reduce the number of workings and alter the time schedule. The timing of BRC workings on rehabilitated areas must be carefully coordinated with the burning and planting.

We do not propose to set up specific standards here for the number or timing of workings because of the wide variation of conditions throughout the region. Following are specifications for estimating and recording future BRC costs.

Revised form M-1059-R1 entitled "Future BRC Costs" will be used to tabulate estimates of future work. The field officers will be concerned only with estimates of work to be done in the next 20 years. All estimates will be based on the latest methods of ribes eradication, and a man-day accomplishment will be that which we would expect from an average regularly paid worker.

The term "man-day" used in this text refers to the so-called "effective man-day" which has been used extensively in past years as the basic unit for measuring work effort in BRC. Effective man-days are the number of 8-hour days expended by workers directly assigned to ribes eradication. The days worked by supervisory and facilitating personnel are not included in the number of effective man-days but are reflected in the cost of the effective man-day.

Each area within the unit will be considered separately. If, on areas of mixed ownership, disturbances in the next 20 years are likely to result in a difference in man-day rate per acre, estimates should be shown separately by classes of ownership. Otherwise, all ownerships may be combined.

The total man-days shown for each area will include all workings necessary to provide adequate protection to the vulnerable stands and should be entered in the column marked "Total man-days." Each BRC staffman is probably familiar with the ways of estimating future work on present established stands, especially if some eradication work has already been done. Control status maps, previous man-day per acre costs, and personal knowledge can be used as guides in estimating future costs. Working conditions vary so greatly that we do not propose to set up a specific formula for making such estimates. Aside from the presently established immature stands, the staffman will be confronted with the problem of making BRC cost estimates on areas to be cut in the next 20 years and on rehabilitated areas. Refer to the table of "Rates for Cost Estimates" when making these estimates.

In the column labeled "How obtained" the staffman should indicate the manner in which he arrived at his estimate. If the particular area had been worked previously and the man-day estimate was made through the use of post check maps and other permanent records, the word "records" should appear.

If an old burn of 525 acres, for example, were to be rehabilitated, enter "525 at 1.5" in the column. If the area is unworked and from personal knowledge you estimate that it will require an average of 2.5 man-days per acre to do the complete job, show "525 at 2.5." If the work is in a buffer strip, indicate the number of acres to be worked and the average total man-days per acre of worked area.

In the next four columns of the form, space has been provided for showing the break-down of the total job by successive workings. The year of each working should be shown in accordance with the proper schedule of timing as discussed above. On areas where other management and silvicultural treatments are planned, it is very important that the time of BRC workings be closely coordinated with the time shown for the other treatments. On areas where only BRC work is involved, the following procedure will apply. For unworked areas the first working should appear in the first of these columns and scheduled for the coming season. If rework is now due on worked areas this also should be scheduled for next season. If an area was worked last season, the time for the next working should be scheduled for 2 to 4 years hence. The sum of the man-days in the four columns for any area should equal the man-days shown under "Total man-days" for that area.

If ribes eradication on any area is likely to be accomplished by contract work or power spray, and it is easier to estimate cost in dollars per acre, use a conversion factor of 1 man-day for every $20 cost.

Stream type will be considered as an area by itself. Chemical costs should be converted to man-days and included in the total.

To establish protection in certain isolated units or in units whose boundaries are not common with those of other white pine units may require work in buffer strips that lie outside the natural geographic boundaries of the unit. This work should be considered as part of the BRC costs for the unit and should be included in the man-day figures on form M-1059-R1.

Up to this point we have considered ribes eradication as the only means of preventing damage by rust. We must not overlook the fact that in certain instances pruning may be a desirable method of reducing damage to a stand. Diversion of regular BRC funds to do pruning should only be considered in extremely meritorious cases. If it becomes permissible to use K-V funds for this purpose, pruning may be done on a larger scale. If pruning is planned as a means of reducing rust damage the cost should be included as part of blister rust control costs and included in future BRC cost estimate.

At the bottom of form M-1059-R1 space has been provided for summarizing the work by years. After the man-days and years of workings have been set up for all areas in the unit a tentative summary may be made. It may be advisable to shift the time of working on certain areas ahead or back a year in order to effect more efficient administration.

When this summary is completed, the form will show the total BRC work to be done and the years in which the work is planned. If the unit contains areas on which K-V funds are to be collected for BRC use, the BRC man-days paid for from K-V funds should be shown under the respective year in which such funds are to be expended.

Once we have set up the BRC man-days by years and the burning, planting and weeding by years, we have in effect then an actual work plan for the unit. Under a given-size program these summaries provide a basis for making annual allotments to the forests. They will also give the forest staffman a guide as to where and how big his program will be in the successive years to follow. We will also be in a much better position to advise the nursery in advance regarding needs for white pine stock.

It is realized that we will not be able to follow these plans to the letter by any means, but here we do have the machinery by which we can make the necessary adjustment to realign our sights towards getting the most white pine out of the money expended.

Past BRC Costs

When the original request was made of the field for data to be used in the Matthews-Hutchison study, it was thought that past BRC costs would have

considerable bearing on the final conclusions derived from the study. As it worked out, however, past costs played a very minor role.

Much time was put in by the fieldmen in accumulating these data, and although little use was made of the information, we did get a fairly complete record of the past BRC man-day expenditures on each unit. For the use to which we are now putting the unit analysis, past BRC costs may become increasingly important.

To foresee all the values that such a record may have in the future is a very difficult job, if not impossible. Already it appears that in the immediate future, past BRC investments may influence our choice of units to be set up for further work, especially among those which are now approaching the condition of maintenance. In a unit of this type the ratio of future BRC against the volume of pine saved as a result of such investment may not look particularly impressive by itself, but when we consider along with it the amount of work already done, we get a very much broader picture of the actual value of the unit.

Revision of the Project Work Inventory for BRC as required by the Chief will be based on the data and estimates prepared for the unit analysis. Past man-day costs kept up to date will be, therefore, essentially a record of accomplishments.

Furthermore, the investment and actual work effort put into a unit will no doubt have considerable effect on the management planning and administration of the unit. It is not impossible that the investments we make in growing timber will be reflected in future sale values.

In view of the foregoing, it appears quite desirable to maintain past BRC man-day costs as part of the unit analysis data. Form M-1058-R1, "Past BRC Costs" has been devised to record these data. In the columns on the left-hand side of the form all man-days expended by organized crews will be recorded. These data will include all the man-days recorded in the permanent records for both stream and upland which were expended in hand pulling, spraying and slashing. The effective man-days of past work for each unit can be obtained from the permanent ribes eradication maps. Man-days will be recorded for each area within the unit and all workings will be included. Eradication data as it is recorded on present maps may often need to be prorated among two or more areas. It will be sufficiently accurate to do this by ocular estimate.

Because of a wide variation in cost per man-day, the man-days will be tabulated by year of work and kind of labor. Data need not be separated by ownership classes.

Stream type will be handled as a separate area within itself. All man-days on hand eradication, chemical eradication and slashing will be combined and tabulated by year of work and type of labor.

The data on contract work will be entered in the upper portion of the right-hand set of columns. Both the actual man-days put in by the operator and the total contract cost in dollars and cents are called for. Contract cost figures should be the gross payment to contractors less penalties.

Data entered under "Chemical costs" should be only for the chemical itself. (Man-days on chemical eradication should be included in the data shown in the left-hand columns or, in the event that chemical eradication is contracted, in the columns directly above.)

For the cost evaluation of earlier sprays, use $0.10 per gallon for sodium chlorate and atlacide and $0.20 for ammonium sulfamate. When the price of hormone chemicals becomes stabilized, a standard rate may be established. Until then forests should obtain chemical costs from their records on price of chemical and concentrations used.

The two right-hand columns on each of the sections on form M-1058-R1 have been left blank. This will enable us to calculate cost of past work either in dollars and cents or in terms of some basic man-day standard when either becomes desirable. Forests need not make entries in these columns nor in the space marked "Totals" at the bottom of the form.

BRC cost estimates and "other cost" estimates for the first 20-year period on each unit will be made on the forest in accordance with outlines described in the foregoing pages. BRC and other cost estimates for subsequent 20-year periods will be made as a separate part of the analysis. A table of rates has been prepared to be used as a guide in making all these estimates (see "Rates for Cost Estimates" in appendix). The BRC rates by age and type of stand described in the table represent the best judgment of experienced men. At a regional meeting of BRC men in December 1948 these rates were reviewed and some revisions were made. The rates need not be applied arbitrarily but rather they are to be used as guides in making estimates in each specific case.

PART III - ANALYSIS PROCEDURE

The following sections are devoted to describing the procedures in making the analysis. A complete analysis of a sample unit is included to illustrate these procedures.

The major processes of the analysis of working units can be outlined as follows:

1. Estimate the yield of white pine in each unit due to future BRC under the conditions of management described on the data sheets. This is accomplished by

   a. Estimating the white pine yield without BRC. (No more BRC from this time forward.)

   b. Estimating the white pine yield with BRC under the conditions specified.

   The net amount of white pine due to BRC is obtained by subtracting a from b.

2. Estimate the future BRC man-day cost per M to produce above yields of white pine. This is accomplished by estimating the total man-days of future BRC work required to produce the net white pine yield due to future BRC obtained in 1 above. This total work divided by the total yield due to the work gives the man-days per M required to produce the white pine attributable to future BRC.

3. Estimate the other management (burning, planting or weeding) cost per M to produce above yields of white pine. This is accomplished by estimating the total man-days of planting, burning and weeding required to supplement the blister rust control. The total other work divided by the total yield of white pine due to future BRC (the same quantity of white pine used in 2 above) gives the man-days per M of other work required to produce the white pine.

4. The BRC cost per M plus the other cost per M gives the total cost of producing the white pine due to blister rust control.

5. Estimate the cost of BRC and other treatments in the next 20 years per M of white pine yield due BRC from present existing stands. This ratio of cost against yield accomplishes two things. It places emphasis on the value of present stands - stands which cannot be replaced. It also provides a guide for distributing funds in the immediate future in the best manner to get the greatest white pine yield from present stands per dollar spent.

6. Estimate the intrinsic white pine producing capacity of the unit. This provides an index by which units can be compared and rated according to their capacity for growing white pine. In long range planning, the units of high capacity will be the ones toward which rehabilitation efforts should be directed.

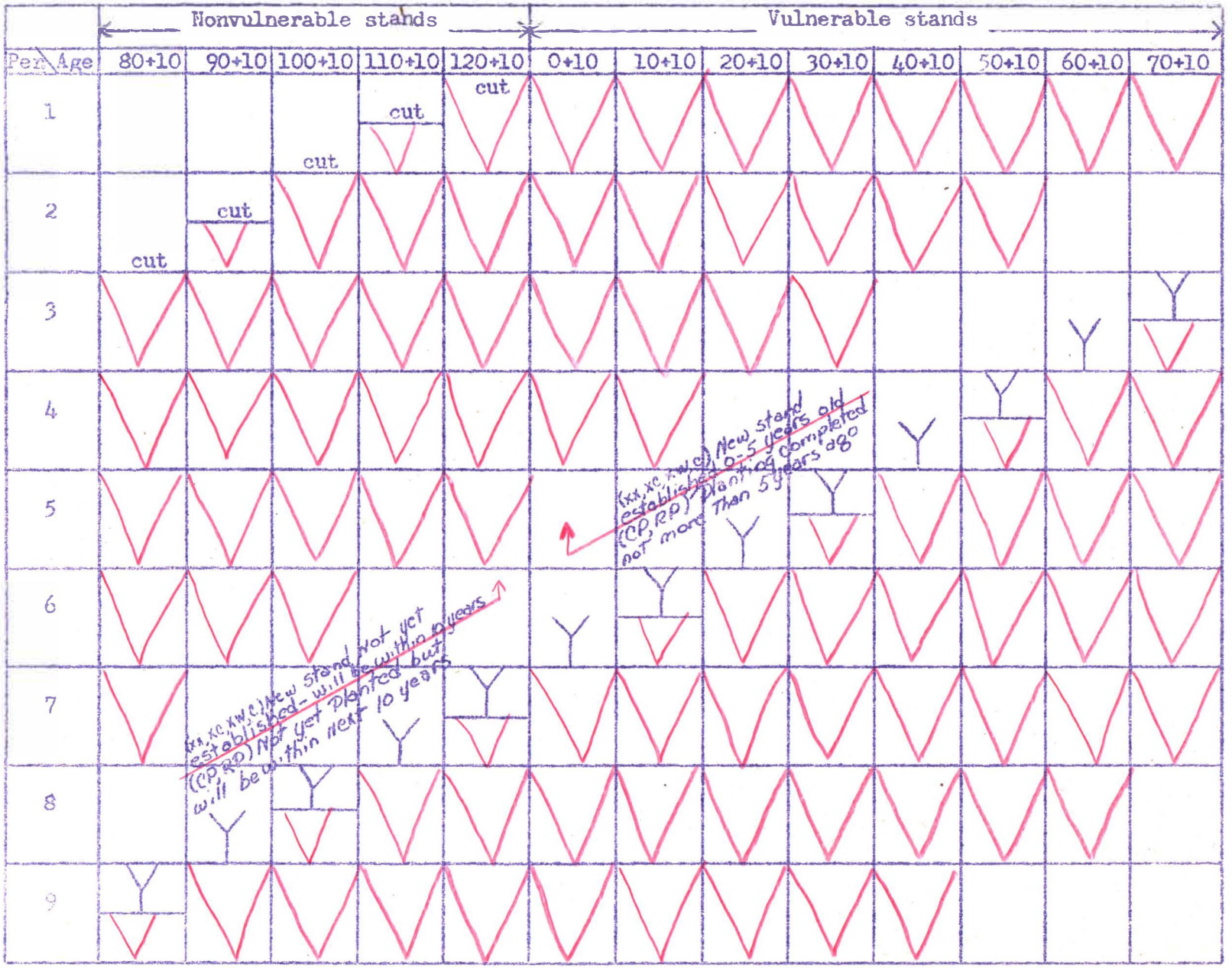
The above is an outline of the analysis. How we actually do the work will be described in more detail here. The first step is to diagram the stands and treatments in each working unit on form M-1060-R1 using the basic information supplied by the forest. Essentially these diagrams indicate for each area in the working unit the 20-year period when it will be harvested, treated for blister rust, burned, planted, weeded, etc. The treatments and their symbols or their abbreviations are those shown in the table of "Rates for Cost Estimates." See also, "Meaning of Symbols..."

Several important reasons exist for the diagrams. They show the relation between stands and they are a handy way to get these relations into the calculations. For example, if area A is cut over and replanted in the third period, it may be necessary to do blister rust control work in adjacent areas B and C just to protect A. The diagrams record such relationships. They also provide a handy method of recording when and where work is required, also, the kind and quantity of work and when and where yields will occur. They are also necessary in order to keep track of the vulnerability of stands. The diagrams help to work out buffer strips to protect vulnerable white pine stands and are an aid in prorating the cost of such strips to the several stands benefited. It is believed that the diagrams not only simplify the computations, but that they reduce errors.

The analysis is designed to cover a sufficient number of 20-year periods so that with a 130-year rotation (120 plus 10-year regeneration period), the complete cycle from harvest to harvest could be included on all white pine areas. This explains the use of nine periods. Nine is the minimum number of periods needed to provide enough time for the complete harvest-to-harvest cycle on all white pine land. One reason for this specification is to carry each area of white pine land through one entire 80-year period of vulnerability. Another way of saying the above is that the analysis is facilitated by having a first crop that has been established and protected from blister rust for one full rotation from each and every white pine area.

Although white pine stands of all ages can be damaged by blister rust, a tree that is not infected until it is approaching maturity may continue to grow, reach merchantable size and be harvested before the rust causes material damage. For the purpose of this analysis we have set the age of 80 plus 10 as the critical age at which a stand becomes "safe," and white pine stands under 80 years of age are considered to be the "vulnerable" stands requiring intensive protection from blister rust. The vulnerability of these young white pine stands is shown on the diagrams by putting a red "V" in each 20-year period during which the stand would be less than 80 years old.

To aid in the preparation of the diagram, the reference chart appearing on the following page has been designed which shows the period of vulnerability and time of harvesting (at age 120 plus 10) of stands of various ages.


Nonvulnerable stands
Vulnerable stands
Per. Age
80+10
90+10
100+10
110+10
120+10
0+10
10+10
20+10
30+10
40+10
50+10
60+10
70+10
1
2
3
4
5
6
7
8
9
cut
cut
cut
cut
cut
(xx, XC, XW, C) New stand established 0-5 years old (CP, RP) Planting completed not more than 5 years ago
(xx, XC, XW, C) New stand not yet established - will be within 10 years (CP, RP) Not yet planted but will be within next 10 years

A set of symbols indicating various silvicultural treatments, types of cutting, etc., for use in constructing the diagram has been developed. See "Meaning of Symbols."

In the making of the stand diagram for a unit under present or high management, all areas capable of producing white pine will be indicated by the red "V" or "/" on the diagram for the first 80 plus 10 years of stand immaturity whether or not there is any pine on the area. The red "V" indicates that the vulnerable white pine stand contains a sufficient stocking of white pine to make it worth while to protect the stand for itself. The red "/" is used to check off vulnerable stands of such low stocking to white pine or high BRC cost that they are either not worked at all or are worked only as a buffer zone for protected stands. It is assumed that all the present undamaged white pine will be saved on the red "V" areas by blister rust control. No white pine yield is assumed due to the BRC on the red "/" areas even when worked as part of a buffer zone. (This is an element of conservatism that tends to substantiate the estimated yields on red "V" areas.)

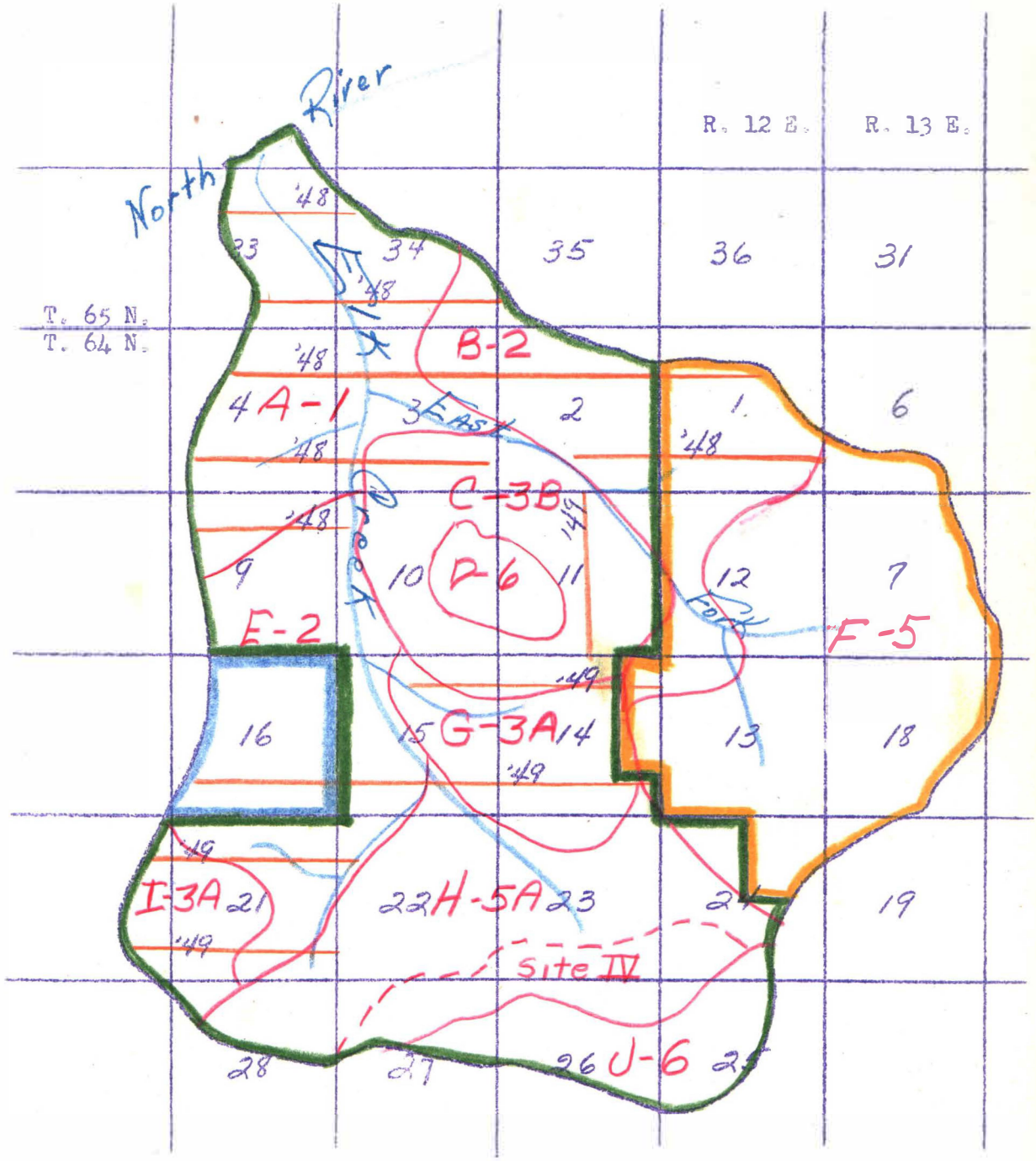
White pine yields on red "/" areas will be calculated only when the diagram indicates that part of the crop will survive under no future BRC conditions. Since the red "/" signified that the pine will not be protected, the same figure for white pine yield on these areas will be used in summarizing white pine yields for the unit with BRC. Hence the net white pine yield due BRC on these areas will be zero.

Areas of class 3, 3A, or 3B which are so located with respect to areas of class 1 and 2 that protection from rust will be afforded them, or, if the cost of protecting the pine on them is commensurate with the values involved, the red "V" will be used to indicate their vulnerability and white pine yields due BRC will be calculated.

Non-white pine areas (i.e., areas designated by BRC classification 6) will not be marked with either a red "V" or a red "/."

If a stand enters a 20-year period at the age of 70 plus 10 it will be considered vulnerable for the entire period.

In the pages that follow, a sample unit is set up complete with map and data forms. The analysis procedure is described step by step from the diagram on. The reader should review the map, area descriptions, and other data carefully in order to familiarize himself with the conditions and proposed treatments on each area before following through with the analysis.



Working Unit No. 44

Elk Creek

Kaniksu National Forest

M-1056-R1

S

CONTROL

Disease

Blister Rust

Sample

WORKING UNIT ANALYSIS
AREA MEASUREMENTS

☑ Inside Control Area

☐ Outside Control Area

Operation Kaniksu

By D.J.M. Date 10/31/49

Working unit: No. 44 Name Elk Creek

Area	Class	Gross area in acres				Net timberland in acres			
		F. S.	State	Other	Total	F. S.	State	Other	Total
A	1	1,681	--	--	1,681	1,597	--	--	1,597
B	2	822	--	795	1,617	805	--	778	1,583
C	3B	1,312	--	--	1,312	1,246	--	--	1,246
D	6	258	--	--	258	258	--	--	258
E	2	1,148	540	--	1,688	1,063	540	--	1,603
F	5	45	--	2,659	2,704	45	--	2,524	2,569
G	3A	700	--	13	713	664	--	13	677
H	5A	2,079	--	16	2,095	2,037	--	16	2,053
I	3A	392	--	--	392	392	--	--	392
J	6	754	--	--	754	754	--	--	754
Stream type		xxxxx	xxxxx	xxxxx		xxxxx	xxxxx	xxxxx	482
TOTALS		9,191	540	3,483	13,214	8,861	540	3,331	13,214

To obtain net timberland acres deduct stream type, lakes, meadows and cultivated land from gross area.

M-1057-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
AREA DESCRIPTION

Operation Kaniksu

By D.J.M. Date 11/1/49

Working unit: No. 44 Name Elk Creek Sheet no. 1 of 5 sheets

Area A Class 1 Age 10 (Nearest 10 years)

Site Index

White Pine
Site I 50 %
" II 50 %
" III ____ %
" IV ____ %

Non White Pine
Show major species & site
Species ____
Site ____

Disease Data

% Infection on white pine 8
% Damage to white pine 3
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____ %, 5 years ____ %, 10 years ____ %, 20 years 61 %.
Remarks 100% at 80 years if no more BRC work is done.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well 75	W.P.	68	
	L,DF,S	21	
Med ____	LPP	8	
Poor ____	Other	3	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ✓
If planted what percent of total area? 75%
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut __ Seed tree cut ____ Multiple cut ✓
Residual salvage __ Hazard removal by burn ____
Reburn of single burn ____ Prescribed burn ____
Pile and burn slash __ Thinning __ Weeding ____
Planting __ Percent of area to be planted ____
Other ____

Remarks Area fully stocked due to WP planting in 1937-38. 2,396 man-days past planting costs.

Area B Class 2 Age 60 (Nearest 10 years)

Site Index

White Pine
Site I ____ %
" II 100 %
" III ____ %
" IV ____ %

Non White Pine
Show major species & site
Species ____
Site ____

Disease Data

% Infection on white pine 26
% Damage to white pine 17
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____ %, 5 years ____ %, 10 years ____ %, 20 years 75 %.
Remarks 75% at 80 years if no more BRC work is done. Area on maintenance except stream zone.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well ____	W.P.	32	
	L,DF,S	35	
Med 60	GF	18	
Poor ____	LPP	15	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ____
If planted what percent of total area? ____
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut __ Seed tree cut __ Multiple cut ✓
Residual salvage __ Hazard removal by burn ____
Reburn of single burn ____ Prescribed burn ____
Pile and burn slash __ Thinning __ Weeding ✓
Planting ___ Percent of area to be planted ____
Other ____

Remarks Above treatment for national forest land at maturity. If area protected pine on private land cut at 90 years.

M-1057-R1

Sample

S-

CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
AREA DESCRIPTION

Operation Kaniksu

By D.J.M. Date 11/1/49

Working unit: No. 44 Name Elk Creek Sheet no. 2 of 5 sheets

Area C Class 3B Age 30 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	____%	Show major
" II	60 %	species & site
" III	40 %	Species ____
" IV	____%	Site ____

Disease Data

% Infection on white pine 64
% Damage to white pine 41
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____%, 5 years ____%, 10 years ____%, 20 years 98 %.
Remarks 100% if no more work is done.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well ____	W.P.	5	
	LPP	39	
Med. ____	L.DF.S	34	
Poor 10	Other	22	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ____
If planted what percent of total area? ____
Indicate T.M. treatments: Planned √ Desirable x
Clear cut __ Seed tree cut ____ Multiple cut __
Residual salvage __ Hazard removal by burn __
Reburn of single burn √ Prescribed burn __
Pile and burn slash __ Thinning __ Weeding __
Planting √ Percent of area to be planted 100
Other ____

Remarks Brushy, nonreproducing single burn. Burning planned in 1950 on whole area. If no BRC assume poorly stocked at maturity. Plant 1955.

Area D Class 6 Age 30 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	____%	Show major
" II	____%	species & site
" III	____%	Species DF
" IV	____%	Site III

Disease Data

% Infection on white pine ____
% Damage to white pine ____
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____%, 5 years ____%, 10 years ____%, 20 years ____%.
Remarks ____

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well ____	W.P.	____	
Med. ____	____	____	
Poor ____	____	____	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ____
If planted what percent of total area? ____
Indicate T.M. treatments: Planned √ Desirable x
Clear cut __ Seed tree cut __ Multiple cut __
Residual salvage __ Hazard removal by burn __
Reburn of single burn √ Prescribed burn __
Pile and burn slash __ Thinning __ Weeding __
Planting __ Percent of area to be planted √
Other ____

Remarks Brushy, dry, south slope not suitable for WP. Burn and plant to DF. Cost of burn and plant not chargeable to WP.

M-1057-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
AREA DESCRIPTION

Operation Kaniksu

By D.J.M. Date 11/1/49

Working unit: No. 44 Name Elk Creek Sheet no. 3 of 5 sheets

Area E Class 2 Age 30 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	%	Show major
" II	75 %	species & site
" III	25 %	Species
" IV	%	Site

Disease Data

% Infection on white pine 21
% Damage to white pine 13
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years %, 5 years %, 10 years %, 20 years 70 %.
Remarks 100% at 80 years if no BRC work is done.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well	W.P.	48	
	GF	23	
Med. 50	L,DF,S	19	
Poor	H,C	10	
	Total	100%	

Timber Management Data

Is present stand natural? ✓ or planted?
If planted what percent of total area?
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut Seed tree cut Multiple cut ✓
Residual salvage Hazard removal by burn
Reburn of single burn Prescribed burn
Pile and burn slash Thinning Weeding ✓
Planting Percent of area to be planted
Other

Remarks Above treatments apply to national forest land when stand reaches maturity. Assume state land cut at 80+10 if protected.

Area F Class 5 Age 160 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	%	Show major
" II	50 %	species & site
" III	50 %	Species
" IV	%	Site

Disease Data

% Infection on white pine
% Damage to white pine
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years %, 5 years %, 10 years %, 20 years %.
Remarks

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well ✓	W.P.	35	
	L,DF,S	40	
Med.	GF	15	
Poor	C,H	10	
	Total	100%	

Timber Management Data

Is present stand natural? or planted?
If planted what percent of total area?
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut Seed tree cut Multiple cut
Residual salvage Hazard removal by burn
Reburn of single burn Prescribed burn
Pile and burn slash Thinning Weeding
Planting Percent of area to be planted
Other

Remarks Private owners plan cutting complete by 1954. Medium stocked mixed at next rotation. Forest Service portion not manageable.

M-1057-R1

Sample

S

CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
AREA DESCRIPTION

Operation Kaniksu

By D.J.M. Date 11/1/49

Working unit: No. 44 Name Elk Creek Sheet no. 4 of 5 sheets

Area G Class 3A Age 30 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	%	Show major
" II	100 %	species & site
" III	%	Species
" IV	%	Site

Disease Data

% Infection on white pine 39
% Damage to white pine 26
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years %, 5 years %, 10 years %, 20 years 96 %.
Remarks 100% if no work is done. Area will be worked to maintenance standards. WP yields should be included.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well 70	W.P.	11	
Med.	C.H	32	
Poor	L,DF,S	29	
	Other	28	
	Total	100%	

Timber Management Data

Is present stand natural? ✓ or planted?
If planted what percent of total area?
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut ✓ Seed tree cut Multiple cut ✓
Residual salvage Hazard removal by burn
Reburn of single burn Prescribed burn ✓
Pile and burn slash Thinning Weeding
Planting ✓ Percent of area to be planted 100
Other

Remarks Above treatments applied at maturity.

Area H Class 5A Age 160 (Nearest 10 years)

Site Index

White Pine		Non White Pine
Site I	%	Show major
" II	40 %	species & site
" III	30 %	Species
" IV	30 %	Site

Disease Data

% Infection on white pine
% Damage to white pine
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years %, 5 years %, 10 years %, 20 years %.
Remarks

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
Well ✓	W.P.	5	
Med. ✓	L,DF,S	55	
Poor ✓	C. H	40	
Residual ✓			
	Total	100%	

Timber Management Data

Is present stand natural? ✓ or planted?
If planted what percent of total area?
Indicate T.M. treatments: Planned ✓ Desirable x
Clear cut Seed tree cut Multiple cut
Residual salvage ✓ Hazard removal by burn
Reburn of single burn Prescribed burn ✓
Pile and burn slash Thinning Weeding
Planting ✓ Percent of area to be planted 70
Other

Remarks 70% of area burn and plant to WP. 30% revert to spruce by burn and plant. Medium stocked and mixed next rotation. Cutting and burning to be completed by 1952.

M-1057-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
AREA DESCRIPTION

Operation Kanikeu

By D.J.M. Date 11/1/49

Working unit: No. 44 Name Elk Creek Sheet no. 5 of 5 sheets

Area I Class 3A Age 30 (Nearest 10 years)

Site Index

White Pine
Site I ____%
" II ____%
" III 100 %
" IV ____%

Non White Pine
Show major species & site
Species ____
Site ____

Disease Data

% Infection on white pine 31
% Damage to white pine 17
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____%, 5 years ____%, 10 years ____%, 20 years 87 %.
Remarks 100% if no work is done. Will be worked to protect adjacent stands only.

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
	W.P.	8	
Well 75+	L, DF, S	46	
Med.	GF	27	
Poor	Other	19	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ____
If planted what percent of total area? ____
Indicate T.M. treatments: Planned /Desirable x
Clear cut ✓ Seed tree cut ____ Multiple cut ✓
Residual salvage ____ Hazard removal by burn ____
Reburn of single burn ____ Prescribed burn ✓
Pile and burn slash ____ Thinning ____ Weeding ____
Planting ✓ Percent of area to be planted 100
Other ____

Remarks Above treatment applied at maturity.

Area J Class 6 Age 160 (Nearest 10 years)

Site Index

White Pine
Site I ____%
" II ____%
" III ____%
" IV ____%

Non White Pine
Show major species & site
Species ____
Site ____

Disease Data

% Infection on white pine ____
% Damage to white pine ____
NOTE: Stocking and composition estimates (above, right) should not include W.P. damaged by blister rust. Estimate of probable loss in undamaged stocking if control action is delayed: 2 years ____%, 5 years ____%, 10 years ____%, 20 years ____%
Remarks ____

Subalpine

Composition and Stocking

For. Sur. Stocking Class	Species	Percent	P. C. Sur. Stems/A
	W.P.	____	
Well ____	____	____	
Med. ____	____	____	
Poor ____	____	____	
	Total	100%	

Timber Management Data

Is present stand natural? ____ or planted? ____
If planted what percent of total area? ____
Indicate T.M. treatments: Planned /Desirable x
Clear cut ____ Seed tree cut ____ Multiple cut ____
Residual salvage ____ Hazard removal by burn ____
Reburn of single burn ____ Prescribed burn ____
Pile and burn slash ____ Thinning ____ Weeding ____
Planting ____ Percent of area to be planted ____
Other ____

Remarks Do not cut. Mostly noncommercial. Leave as cap.

S
CONTROL
Disease
Blister Rust

Sample
WORKING UNIT ANALYSIS
OTHER COSTS - SUPPLEMENTAL FUNDS
(First 20-Year Period)

M-1075-R1

Operation Kaniksu

By D.J.M. Date 12/5/49

Working unit: No. 44 Name Elk Creek

Management Level
Present ☑ High ☐

Area and class	Type of treatment	Man-days required	Year of treatment	Supplemental funds collectible in equivalent man-days (Use $20 per man-day)**			Man-days to be paid from P&M	
				Slash	K-V			
C-3B	Burn	1,246	1950				1,246	
	Plant	2,492	1955				2,492	
	Weed	--						
	BRC	1,869	1953				1,869	
H-5A	Burn	1,868	1952	1,868				
	Plant	2,874	1958		1,796		1,078	
	Weed	--						
	BRC	1,676	1955				1,676	
	Burn							
	Plant							
	Weed							
	BRC							
	Burn							
	Plant							
	Weed							
	BRC							
	Burn							
	Plant							
	Weed							
	BRC							
	Burn							
	Plant							
	Weed							
	BRC							
Totals	Other	8,480		1,868	1,796		4,816	
	BRC	3,545					3,545	

Summary by Years

Year	Burning		Planting		Weeding		BRC	
	Supp.	P&M	Supp.	P&M	Supp.	P&M	Supp.	P&M
1950		1,246						
1952	1,868							
1953								1,250
1955				2,492				1,250
1958			1,796	1,078				799
1961								246

**Show equivalent man-days for only those funds that will be used directly for white pine production (i.e., prescribed burning, ground preparation, planting, weeding and for control of blister rust). Funds to be used for other purposes such as piling and burning of slash should not be included. In estimating amounts collectible from future cuttings, show maximum amount collectible that will be used for purposes described above.

S

Sample

M-1059-R1 (Revised November 1949)

CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
FUTURE BRC COSTS
(First 20-Year Period)

Operation Kaniksu

By D J.M. Date 12/5/49

Working unit: No. 44 Name Elk Creek

Management Level
Present ☑ High ☐

Area and class	Owner-ship	Total man-days	How obtained	Next working		First follow-up		Second follow-up		Third follow-up	
				Man-days	Year	Man-days	Year	Man-days	Year	Man-days	Year
A-1	FS	400	Records	250	1950	150	1953				
B-2	All	75	Records	60	1950	15	1953				
C-3B	FS	1,869	1246@1.5	1,250	1953	420	1955	199	1958		
D-6	FS	387	258@1.5	260	1953	85	1955	42	1958		
E-2	All	1,200	Records	800	1950	400	1953				
F-5	All	5,138	2569@2	2,570	1955	1,600	1958	968	1961		
G-3A	All	915	Records	580	1950	335	1953				
H-5A	All	1,676	2053@.8	830	1955	600	1958	246	1961		
I-3A	All	784	392@2	400	1950	280	1953	104	1955		
J-6	FS	1,885	754@2.5	1,130	1955	500	1958	255	1961		
Stream	All	964	482@2	330	1950	330	1953	200	1955	104	1958
A-1	Buffer	100	100@1	60	1950	40	1953				
E-2	Buffer	60	60@1	40	1950	20	1953				
Total		15,453									

Summary

Year	1950	1953	1955	1958	1961
Man-days	2,520	3,080	5,339	3,045	1,469

S
CONTROL
Disease
Blister Rust

Sample M-1058-R1 (Revised November 1949)

WORKING UNIT ANALYSIS
PAST BRC COSTS

Operation Kaniksu

By D.J.M. Date 12/13/49

Working unit: No. 44 Name Elk Creek

Eradication Work by Organized Crews

Area and class	Year of work	Kind of labor	Man-days	Conversion factor	Equiv. regular man-days
A-1	1934	CCC	1,654	0.5	827
	1937	FS Reg.	1,210	1.0	1,210
	1945	Mex.	250	1.0	250
B-2	1934	CCC	910	0.5	455
	1937	FS Reg.	681	1.0	681
C-3B	1934	CCC	875	0.5	438
	1945	Mex.	1,143	1.0	1,143
D-6			NONE		
E-2	1934	CCC	2,112	0.5	1,056
	1938	FS Reg.	1,578	1.0	1,578
	1945	Mex	620	1.0	620
F-5	1934	CCC	324	0.5	162
	1938	FS Reg.	222	1.0	222
G-3A	1934	CCC	750	0.5	375
H-5A			NONE		
I-3A			NONE		
J-6			NONE		
Stream	1934	CCC	475	0.5	237
	1937	FS Reg.	242	1.0	242
	1938	FS Reg.	127	1.0	127
	1945	Mex.	88	1.0	88
Total			13,261		9,711

Eradication Work by Contract

Area and class	Year of work	Oper. man-days	Total contract cost	Conversion factor	Equiv. regular man-days
A-1	1948	102	$2,176		102
	1949	78	$1,248		78
B-2	1949	43	$ 835		43
Total		223	$4,259		223

Chemical Costs

Area and class	Kind of chem.	Gals. of spray	Total chemical cost	Conversion factor	Equiv. regular man-days
Stream	Atl.	5,020	$502	100	50
	Amm.	950	$190	50	19
Total		5,970	$692		69

Eradication Work by Machine (Bulldozer)

Year of work	Total cost of project	Conversion factor	Equiv. regular man-days
1935	$1,280	$7.50	171
Total	$1,280		171

TOTALS

Item	Amount
Equivalent man-days	10,174

Meaning of Symbols and Abbreviations Used on the Diagrams (See also the "Rates for Cost Estimates")

Y or Ymc	Time of yield of white pine and other species. Use yield table for 130-year rotation with intermediate cuttings (multiple cut). Position of the bar in the column indicates time of yield.
Y' or Y'mc	Time of yield of other species. No white pine in the stand. If yield is computed use multiple cut yield table with appropriate reduction in total yield according to predominant species (see table for "Estimated Correction of Yields").
Yc	Time of yield of white pine and other species. Use single cut yield tables.
Y'c'	Time of cut of other species. No white pine in stand. Use single cut yield tables.
Yc	Followed by Y'c' in same column 2 periods later indicates that white pine is removed in a single cut when 80 plus 10 years of age and the other species are removed in a single cut 40 years later. In the analysis it is assumed that the stand must be 25 percent or more white pine in order to make this treatment applicable.
cut	Indicates the time of cutting a stand for which the yield is not estimated.
xx	Multiple cut for maximum yield and to minimize ribes. Natural regeneration to white pine. This symbol applies to stands of 60 percent white pine or more and where ribes potential was reduced at birth of the stand by prescribed burning or by devitalization and futile germination. See "Rates for Cost Estimates."
xc	Multiple cut in stands of 60 percent or more white pine. Same as xx but where ribes potential was not reduced at birth of stand. Generally xc will apply when harvesting present established natural stands or those which were planted without prescribed ground preparations.
xw	Multiple cut same as xc but where white pine constitutes not more than 59 percent or less than 25 percent of the stand composition and weeding is necessary to increase white pine potential.
w	Weeding present stands up to 10 years of age at 2 man-days per acre.

For the purpose of calculating yields, it is assumed that stands established by xx, xc, xw, and w treatments will be of such composition that 70 percent of the volume at maturity will be white pine.

CP	Clear cut (or residual salvage), burn and plant. Ground preparation usually accomplished by two successive burnings. See "Rates for Cost Estimates" for BRC, burning and planting costs per acre.
RP	Reburn of a single burn followed by planting. See "Rates for Cost Estimates" for BRC, burning and planting costs.
	It is assumed that 80 percent of the volume at maturity will be white pine on areas planted to white pine through CP and RP treatments.
25%, 50%	Etc., below the time of yield bars on the "No Future BRC" diagrams is an estimate of the percent of the white pine yield that will be obtained without future BRC.
Red "V"	Vulnerable white pine stand under 80 years of age worked to protection standards and for which BRC work is done in adjacent buffer areas to accomplish protection.
Red "/"	Vulnerable white pine stands without sufficient white pine to be worked to protect itself. (See text above for a more complete explanation of these last two symbols.)
(.8), (2)	Number in circle is the estimate of man-days BRC work per acre on area in period where it is shown.
(M)	No maintenance in period and column where shown. (Maintenance at .1 man-day per acre per 20-year period is figured on entire gross area of a working unit for each period showing red "V" vulnerable stands unless the "no maintenance" symbol or other notation indicates otherwise. (M) applies only in the 20-year period it is shown. No maintenance will be figured for the unit in periods where no vulnerable stands exist.)
1/2M, 1/3M	Indicates proportionate amount of area on which maintenance cost will be figured in period shown. This symbol is used only on large areas where maintenance costs for the whole area would represent a considerable number of man-days. Usually on most areas maintenance costs will be considered for the whole area or not at all.

M-1060-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS - STAND DIAGRAM

~~Future BRC~~ | ~~Present Management~~
~~Yield~~ | ~~High Management~~
~~Other Costs~~ | No Future BRC

(Draw a line through above words that do not apply)

Operation Kaniksu
Working unit no. 44
Name Elk Creek
By D J M. Date 12/5/49

	NF 1,597	NF 805	778	NF 1,246	258	NF 1,063	540	NF 45	2,524	677	NF 2,053	NF 392	NF 754	482 = 13,214
	A-1	B-2	B-2	C-3B	D-6	E-2	E-2	F-5	F-5	G-3A	H-5A	I-3A	J-6	Stream	TOTALS
1								cut	cut		cut				
2															
3		Ymc 25%	Yc 25%												
4													Do not cut		
5				Y'c' 0%	cut	Y"mc 0%	Y'c' 0%			Y"mc 0%		Y'mc 0%			
6	Y'mc 0%														
7								Y'c' 0%	Y'c' 0%		Y"mc 0%				
8															
9															

Procedure for Making Stand Diagram for the Elk Creek Sample Unit Under "No Future BRC"

1. Heading filled out as shown. National forest land and land of other ownerships are shown in separate columns for each area having mixed ownership. (If either national forest or "other" land is less than 40 acres, segregation is not made.) The stream type acreage and gross acreage of unit is also shown.

2. Area A-1, a 10-year-old, well-stocked stand, all national forest land, is manageable and the stand will be multiple cut in the sixth period. No pine will be left at maturity if no more BRC work is done - hence the symbols $\frac{Y^{1}mc}{0\ \%}$.

3. B-2, a 60-year-old medium-stocked stand of mixed ownership, will be cut by the end of the third period. Twenty-five percent of the pine is expected to survive even though no more BRC work is done. The national forest portion is manageable and will be multiple cut. Because the rust will reduce the amount of pine to less than 25 percent of the stand by age 80 plus 10, it is assumed that no cutting will take place on private land until age 120 plus 10 at which time the harvest will be done at a single cutting.

4. C-3B is a 30-year-old stand very poorly stocked and brushy. Because of the poor stocking, harvest will be made on a single cut basis if the stand is cut at all.

5. D-6, a south-facing slope dry site, is non-white pine land. No yields will be calculated.

6. E-2 is a natural stand of white pine and mixed 30 years of age. National forest portion is manageable and will be multiple cut in the fifth period. White pine will experience complete damage from rust if no more BRC work is done. The 540 acres of state land will be cut on a single cut basis.

7. F-5, a 160-year-old mature stand, is expected to be cut by 1954. The national forest land is small in amount and scattered so management is impractical. With no BRC the stand will revert to mixed, probably be well stocked (this is indicated by the fact that the present stand is well stocked) and will have a composition proportionate to the present percentage of mixed species.

8. G-3A and I-3A, 30-year old stands, well stocked but with small percentages of white pine, will be harvested in the fifth period. With no BRC, no white pine will survive. All national forest land and manageable will be multiple cut.

9. H-5A heavy residual. Salvage cuttings are planned for 1952. May produce medium stocked mixed stand at next rotation, probably running heavily to cedar and hemlock.

10. J-6, subalpine mostly noncommercial, will probably remain undisturbed.

M-1060-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS - STAND DIAGRAM

Future BRC | Present Management
~~Yield~~ | ~~High Management~~
~~Other Costs~~ | ~~No Future BRC~~

Operation Kaniksu
Working unit no. 44
Name Elk Creek
By D.J.M. Date 12/5/49

(Draw a line through above words that do not apply)

	A-1	B-2	B-2	C-3B	D-6	E-2	E-2	F-5	F-5	G-3A	H-5A		I-3A	J-6	*	TOTALS
	NF 1,597	NF 805	778	NF 1,246	NF 258	NF 1,063	540	NF 45	2,524	NF 677	NF 2,053		NF 392	NF 754	Stream = 482 Gross = 13,214	
1	✓	✓	✓ Yc (1.25)	RP ✓		✓	✓	cut /	cut /	✓	CP ✓	/	/		15,453	15,453
2	✓			✓		✓	✓	/	/	✓	✓	/	/		2,217	2,217
3	✓	Ymc (4) xw ✓	Y'c' (2) /	✓		✓	~~Yc~~ ✓ (1.25)	/	/	✓	✓	/	/	not cut	1,942	1,942
4	✓			✓				/	/		✓	/			2,554	3,041
5		✓	/	✓		Ymc (4) ✓xw	Y'c' (2) /	/	/	Ymc (8) ✓CP	✓	/	Y'mc (8) ✓CP	Do	1,639	3,415
6	Ymc (4) ✓xc	✓	/		(M)	✓	/		1/3M	✓			✓	(M)		1,531
7	✓	✓	/	Ymc (2) ✓xx	cut (2)	✓	/	Y'c' (3)	Y'c' (1.5)	✓	Ymc (2) xx ✓	cut (2)	✓			1,677
8	✓	✓	/	✓		✓	/	/	/	✓	✓	/	✓			4,986
9	✓			✓		✓	/	/	/	✓	✓	/	✓			1,321

*Charge to first crop.

1,437A → ← 616A Site IV (Spruce)

23,805 35,583

Procedure for Making Stand Diagram for the Elk Creek Sample Unit Under "Present Management"

1. Heading filled out practically the same as on diagram for "No Future BRC" except for marked out words and the addition of words "Charge to first crop" at the head of the second column from the right. (For definition of "first crop" and for procedure in estimating BRC cost beyond the first 20-year period, see page immediately following this procedure description.)

2. Area A-1 is vulnerable through fourth period. Multiple cut in sixth period. Since the stand is 68 percent white pine and a high ribes potential exists, the cutting symbol is xc. See "Meaning of Symbols" and "Rates for Cost Estimates." The .4 is the BRC cost rate per acre under these conditions.

3. The national forest portion of B-2 will be multiple cut in the third period and since the percentage of pine is less than 60 percent and more than 25 percent, the area will be restocked through natural seeding but will require a weeding treatment - hence the symbol xw. With BRC the privately owned portion will have 32 percent white pine at age 80 plus 10 and it is assumed the pine will be cut at that age. The mixed will be cut at age 120 plus 10. Both cuttings will be made on a single cut basis.

4. The brushy area C-3B is set up for a reburn in 1950 and to be planted in 1955. This will produce a well-stocked stand to be multiple cut in the seventh period Since the stand will be more than 60 percent white pine and the ribes potential will be reduced by burning and ribes eradication after burning at the beginning the symbol xx is applicable here.

5. Area D-6 will be burned at the same time as C-3B; plans are to plant D-6 to Douglas-fir. The burning and planting costs are not chargeable to white pine, however. The time of cutting and BRC cost involved on D-6 are the only items of concern.

6. The national forest portion of E-2 is manageable and will be multiple cut in the fifth period. Being 48 percent white pine, the re-establishment of white pine after cutting will require a weeding treatment - hence symbol xw. On state holdings it is expected that the pine will be cut at age 80 plus 10 and mixed at 120 plus 10 with no provision made for re-establishment of white pine.

7. The F-5 area will be treated under present management the same as with no BRC. Since much of the private land in F-5 is remote from Forest Service restocked area, the intensity of BRC work done in the eighth period is assumed to be much less than normal - hence indicates (1.5) the average BRC man-days per acre.

8. As stated on the Area Description form, area G-3A will be worked to protection standards due to its location with respect to rehabilitated areas. Pine yields will be calculated and the vulnerable periods are marked with a red "V." After multiple cutting in the fifth period a clear-cut, burn and plant, i.e., CP treatment, is necessary since the percentage of pine (11%) in the present stand is less than the minimum (25%) for the natural reseeding process.

9. H-5A is scheduled for rehabilitation within next 10 years. The 30 percent site IV, 616 acres, will be stocked to spruce. The burning and planting cost for this portion is not chargeable to white pine. At harvest in the seventh period the stand conditions will conform with the specifications for xx treatment.

10. J-3A will be worked only for the protection of adjacent stands. Therefore, no white pine yield will be estimated for this area. The vulnerable periods are marked with a red "/." A CP treatment is planned for next rotation.

11. J-6 will remain undisturbed except for the ribes eradication necessary to protect vulnerable stands in the drainage below.

12. Areas D-6 and J-6 are so remote from vulnerable pine stands in the sixth period that no maintenance work on them is required - hence (M). Likewise, the majority of F-5 requires no maintenance work. It is estimated that only one-third of this large area will require attention - thus the symbol 1/3 M.

On those units which are to be sent to the regional office for final computations and summarization, the completion of the stand diagrams to the extent described above represents the final step in the development of the analysis as far as the forest is concerned.

Procedures covering final computations and summarization are described in the pages that follow.

Definition of "First Crop"

The term "first crop" refers to the first yields of white pine from vulnerable areas which were produced under the handicap of blister rust. Actually, in the analysis, the only white pine yield figures calculated are "first crop" yields. Therefore, to get a true ratio of cost versus yields, the cost figures used should be only those which are expended directly for the production of white pine first crop yields. Any work done for the establishment and protection of future yields not figured in the analysis should not be included in the calculation of cost yield ratios.

In the sample unit, the "first crop" on area A-1 is the crop harvested in the sixth period. On B-2 the "first crop" is that which produces white pine yields at the end of the third period (national forest lands), and on C-3B and H-5A the "first crop" yields are obtained in the seventh period.

That portion of the BRC work done solely for the protection of the newly established vulnerable stand in B-2 from the fourth period on contributes to future white pine yields not calculated, and therefore should not be charged against first crop yields.

In the fourth and fifth periods there are vulnerable stands of both first and second crop so that only part of the BRC work is chargeable to first crop. In the sixth period all "first crop" stands either have been harvested or have reached the "safe" age.

M-1060-R1

S
CONTROL
Disease
Blister Rust

Sample - Illustrating procedure
for estimating future BRC costs

WORKING UNIT ANALYSIS - STAND DIAGRAM

Future BRC | Present Management
~~Yield~~ | ~~High Management~~
~~Other Costs~~ | ~~No Future BRC~~

(Draw a line through above words that do not apply)

Operation Kaniksu
Working unit no 44
Name Elk Creek
By D.J.M. Date 12/15/49

	NF 1,597 A-1	NF 805 B-2	778 B-2	NF 1,246 C-3B	NF 258 D-6	NF 1,063 E-2	540 E-2	NF 45 F-5	2,524 F-5	NF 677 G-3A	NF 2,053 H-5A		NF 392 I-3A	NF 754 J-6	Stream = 482 Total = 13,214 *	TOTALS
1															15,453	15,453
2			1.25		Mtnc. on 13,216 = 778 or 12,436A.										2,217	2,217
3			Mtnc. on 13,214 = 540 or 12,674A. cut (2)				1.25								1,942	1,942
4		.4		Mtnc. on 11,631A.				1st crop vul. area 84% of total							2,554	3,043
5	Mtnc. on 10,542A.					.4	cut (2)	1st Crop % = 48%		.8			cut .8		1,639	3,415
6	.4	Mtnc. on 8,922A.			M		1st Crop % = 0		1/3M					M		1,531
7	Mtnc. on 9,857A.			.2	cut (2)			cut (3)	cut 1.5		.4	.2				1,677
8		Mtnc. on 10,645A.														4,986
9							Mtnc. on 13,214A.									1,321

*Charge to first crop

1,437A → ← 616A

23,805 35,583

Specifications for estimating future BRC costs for each of the 20-year periods may best be explained with the aid of the skeleton diagram shown on the preceding page. For ease in segregating "first crop" and "second crop" vulnerable areas, the red "V's" are inverted for "second crop" stands. Man-day rates, after cuttings, are taken from the table of "Rates of Cost Estimates."

1st Period — BRC man-days are taken directly from form M-1059-R1 and all work is chargeable to first crop.

2nd Period — 778 acres of B-2 at 1.25 MD/A equals 973 man-days. The maintenance cost on the remaining 12,436 acres at 0.1 MD/A requires 1,244 man-days, making a total for the period amount to 2,217 man-days all chargeable to first crop.

3rd Period — 540 acres at 1.25 MD/A plus maintenance cost on 12,674 acres makes a total of 1,942 man-days for period. Again, the man-days are chargeable to first crop.

4th Period — BRC work on B-2 and maintenance on 11,631 acres total 3,041 man-days for period. Here we have vulnerable stands of both first and second crops. BRC work done on an area not only is effective in protecting pine on the area itself but also contributes to the protection of pine on adjacent areas. To simplify calculations, we have adopted the procedure of dividing the BRC work between first and second crop stands in direct proportion to the number of acres of vulnerable area in each crop class. In the fourth period there is a total of 5,085 acres supporting vulnerable stands. 4,280 acres, or 84 percent, are first crop areas. Thus 84 percent of 3,041 or 2,554 man-days are chargeable to the first crop.

5th Period — BRC work totals 3,415 man-days. 48 percent of the area supporting vulnerable stands is involved in the first crop figure - hence 48 percent of 3,415 or 1,639 man-days are chargeable to first crop.

6th Period — Areas D-6 and J-6 and the bulk of the private land in F-5 are so remote from vulnerable stands in this period that no maintenance is figured for D-6 and J-6 and only one-third of F-5 (private) is considered for maintenance work. All vulnerable stands are second crop.

7th to 9th Periods — The same procedures described above apply to BRC estimates in these periods and all work is chargeable to second crop.

Other Costs

The diagram form M-1060-R1 can be used to tabulate other costs by periods. Other cost tabulations for the sample unit appear on the following page. Here again the costs chargeable to "first crop" are shown separately. Other costs in the first 20-year period are expended to establish first crop stands. Burning, planting, and weeding operations in the fourth and fifth periods are done entirely for the establishment of second crop stands.

Estimate of Yields

The next step in the analysis is to estimate white pine yields on each area under the conditions described on the Area Description form, M-1057-R1. Form M-1061-R1 has been designed for use in making yield computations. Yields have been computed for the sample unit in the following pages. Each step in the procedure is described on the page following the calculations.

General instructions covering yield calculations are as follows:

a. Yields of white pine only will be calculated.

b. Yield calculations will be made only for those areas producing first crop white pine yields. In the sample unit areas A-1, B-2, C-3B, E-2, G-3A, and H-5A will be set up for yield estimates.

c. On areas of mixed ownership yields on national forest lands will be calculated separately.

d. Except in special cases yields will be calculated for white pine areas under two sets of conditions, namely, "No Future BRC" and "Present Management." When all yields have been estimated and summarized, the difference in total yields obtained under the two sets of conditions is attributable to BRC and "other cost" effort.

e. Present age of stand, composition, site quality of area, degree of stocking and expected damage if no further BRC work is done are obtained from the Area Description form, M-1057-R1. The period of harvest, acres of land by ownership class, type of cutting, and the age of the stand at harvest are obtained from the stand diagrams.

M-1060-R1

Sample

WORKING UNIT ANALYSIS - STAND DIAGRAM

S
CONTROL
Disease
Blister Rust

~~Future BRC~~ | Present Management
~~Yield~~ | ~~High Management~~
Other Costs | ~~No Future BRC~~

Operation Kaniksu
Working unit no. 44
Name Elk Creek
By D J M. Date 12/13/49

(Draw a line through above words that do not apply)

								Charge to first crop				Total other costs			
								B	P	W	Total	B	P	W	TOTALS
1								3,114	5,366	---	8,480	3,114	5,366	---	8,480
2															
3															
4														1,610	1,610
5												1,390	2,138	2,126	5,654
6															
7															
8															
9															
								3,114	5,366	---	8,480	4,504	7,504	3,736	15,744

M-1061-R1 (Rev. March 1947)

Sample

S = CONTROL

Disease = Blister Rust

WORKING UNIT ANALYSIS
YIELD COMPUTATIONS

Operation Kaniksu Working unit no. 44

Name Elk Creek

By D.J.M. Date 12/5/49

	Site	%	Net acres	Y per acre	Total yield	Total WP yield		No future BRC	Present management	High management
Area A-1	I	50	798	X 83	= 66,234			All	All	All
Age now 10	II	50	799	X 65	= 51,935					
☑ NF	III			X	=					
☐ Other	IV			X	=			Period	Period	Period
Age cut 120+10										
% WP 68	→			X 118,169	= 80,355	X 0 % WP not lost =		WP C	WP 80,355	WP
% WP lost 100						X % Loss not rec. =				
Stocking 75								Period 6	Period 6	Period
Area	I			X	=			All	All	All
Age now	II			X	=					
☐ NF	III			X	=					
☐ Other	IV			X	=			Period	Period	Period
Age cut										
% WP	→			X	=	X % WP not lost =		WP	WP	WP
% WP lost						X % Loss not rec. =				
Stocking								Period	Period	Period
Area	I			X	=			All	All	All
Age now	II			X	=					
☐ NF	III II			X	=					
☐ Other	IV			X	=			Period	Period	Period
Age cut										
% WP	→			X	=	X % WP not lost =		WP	WP	WP
% WP lost						X % Loss not rec. =				
Stocking								Period	Period	Period

YIELD COMPUTATIONS FOR ELK CREEK SAMPLE UNIT

Area A-1

1. In the first left-hand column on form M-1061-R1 space is provided for area designation and class, present age of stand, ownership, age of stand at harvest, percent of white pine in stand, percent of white pine lost if no BRC work is done, and degree of stocking.

2. The next step is to show net acres of timberland by site class.

3. The stand diagram shows multiple cut on this area at age 120 + 10. Use revised yield table for multiple cutting at 130-year rotation (see yield tables in appendix). This table shows that for a stand now 10 years of age and 75% stocked we can expect a yield of 83 M per acre on land of site I quality. Total yield on the 798 acres of site I is expected to be 66,234 M. Similarly, on site II a yield of 65 M per acre, or 51,935 M on the 799 acres is expected. Total expected yield for the area is 118,169 M.

4. Since by composition the stand is 68 percent white pine, the white pine yield if protected from blister rust is estimated to be 80,355 M.

5. In the three columns on the right-hand side of the form space is provided for showing estimates of yields of all species, estimates of white pine yields, and period in which yields are obtained under the three sets of management conditions. As described in the preceding pages, we will confine our estimates to white pine only under "No future BRC" and "Present management." On area A-1 no pine will survive with no BRC work, hence 0 white pine when stand is cut in the sixth period. With BRC under "Present Management" we will get the full yield of white pine, or 80,355 M in the sixth period.

M-1061-R1 (Rev. March 1947)

S - CONTROL
Disease - Blister Rust

Sample
WORKING UNIT ANALYSIS
YIELD COMPUTATIONS

Operation Kaniksu Working unit no. 44
Name Elk Creek
By D.J.M. Date 12/5/49

	Site	%	Net acres	Y per acre	Total yield	Total WP yield	No future BRC	Present management	High management
Area B-2 Age now 60 ☑ NF ☐ Other Age cut 120+10	I			X	=		All	All	All
	II	100	805	X 61	= 49,105				
	III			X	=		Period	Period	Period
	IV			X	=				
% WP 32 % WP lost 75 Stocking 60	→				X 49,105 =	15,714 X 25 % WP not lost =	WP 3,929	WP 15,714	WP
						X % Loss not rec. =	Period 3	Period 3	Period
Area B-2 Age now 60 ☐ NF ☑ Other Age cut 120+10	I			X	=		All	All	All
	II	100	778	X 46	= 35,788				
	III			X	=		Period	Period	Period
	IV			X	=				
% WP 32 % WP lost 75 Stocking 60	→				X 35,788 =	11,452 X 25 % WP not lost =	WP 2,863	WP	WP
						X % Loss not rec. =	Period 3	Period	Period
Area B-2 Age now 60 ☐ NF ☑ Other Age cut 80+10	I			X	=		All	All	All
	II	100	778	X 22	= 17,116				
	III			X	=		Period	Period	Period
	IV			X	=				
% WP 32 % WP lost 75 Stocking 60	→				X 17,116 =	5,477 X % WP not lost =	WP	WP 5,477	WP
						X % Loss not rec. =	Period	Period 1	Period

Area B-2

1. Yield calculations on national forest lands and lands of other ownerships will be made separately. The national forest land will be considered first.

2. The stand diagram shows yields are to be obtained through multiple cut at age 120 + 10 in the third 20-year period. The revised multiple cut yield table at 130-year rotation will be used. The table shows that a stand now 60 years of age and 60 percent stocked will produce 61 M per acre on land of site II quality. We can expect a total yield of 49,105 M on the 805 acres. 32 percent of the stand is white pine. Thus, if protected, the stand is expected to produce 15,714 M of white pine.

3. According to the Area Description form, 25 percent of the white pine will survive even though no more BRC work is done. Hence we can expect a white pine yield of 0.25 x 15,714 or 3,929 M in the third 20-year period under "No future BRC" conditions. If full protection is afforded the stand as prescribed under "Present management" conditions we can expect the full yield of white pine or 15,714 M in the third period.

4. Consider next the yields on lands of private ownership in B-2. Because of the reduction in white pine volume due to blister rust no cutting is anticipated on the private land until age 120 + 10 if no BRC work is done. At that time the timber will be harvested at a single cut. Use the yield table set up for single cut at 130-year rotation. This table shows an expected yield from a stand now 60 years old and 60 percent stocked to be 46 M per acre on land of site II quality, or 35,788 M on the 778 acres.

5. Were the stand protected from rust we could expect the 32 percent white pine or 11,452 M to be harvested. However, with no BRC only 25 percent of the pine will survive. Hence, 2,863 M of white pine is expected at the single cut harvest in the third period on the private land.

6. If BRC work is done as prescribed under "Present management" conditions the private owner is expected to cut the white pine in the first 20-year period at age 80 + 10. Using the yield table for single cut harvest at 90-year rotation a 60-year-old stand 60 percent stocked is expected to yield a total of 22 M per acre or 17,116 M on the 778 acres. 32 percent being white pine the white pine yield on the private portion of B-2 from the single cut at age 80 + 10 in the first period is estimated to be 5,477 M.

M-1061-R1 (Rev. March 1947)

Sample

S - CONTROL

Disease - Blister Rust

WORKING UNIT ANALYSIS
YIELD COMPUTATIONS

Operation Kaniksu Working unit no. 44

Name Elk Creek

By D.J.M. Date 12/5/49

	Site	%	Net acres	Y per acre	Total yield	Total WP yield		No future BRC	Present management	High management
Area C-3B Age now 30 ☑ NF ☐ Other Age cut 120+10	I		X	=				All / Period	All / Period	All / Period
	II	60	748 X 65	=	48,620					
	III	40	498 X 45	=	22,410					
	IV		X	=						
% WP 80 % WP lost 100 Stocking 75+	→		X	71,030 =	56,824	X ___ % WP not lost =		WP 0	WP 56,824	WP
						X ___ % Loss not rec. =		Period 5	Period 7	Period
Area E-2 Age now 30 ☑ NF ☐ Other Age cut 120+10	I		X	=				All / Period	All / Period	All / Period
	II	75	797 X 57	=	45,429					
	III	25	266 X 39	=	10,374					
	IV		X	=						
% WP 48 % WP lost 100 Stocking 50	→		X	55,803 =	26,785	X 0 % WP not lost =		WP 0	WP 26,785	WP
						X ___ % Loss not rec. =		Period 5	Period 5	Period
Area E-2 Age now 30 ☐ NF ☑ Other Age cut 80+10	I		X	=				All / Period	All / Period	All / Period
	II	75	405 X 21	=	8,505					
	III	25	135 X 12	=	1,620					
	IV		X	=						
% WP 48 % WP lost 100 Stocking 50	→		X	10,125 =	4,860	X ___ % WP not lost =		WP / Period	WP 4,860	WP
						X ___ % Loss not rec. =			Period 3	Period

Area C-3B

1. All national forest land. Under present management, rehabilitation by prescribed burn and planting is planned. Multiple cutting is planned at age 120 + 10. Total yield from a normal stand under these conditions is expected to be 65 M per acre on site I and 45 M per acre on site II, making a total of 71,030 M for the entire area.

2. Because of opening resulting from nonsurvival, spots unsuitable for planting and various other reasons, a certain percentage of mixed species can be expected to appear in the final composition of the stand. For purposes of this analysis we will assume that plantations will average 80 percent white pine. Under "Present management" conditions we can expect a yield of 0.80 x 71,030, or 56,824 M white pine at harvest in the seventh period.

3. With no BRC the area, of course, will not be rehabilitated to white pine. As indicated on the Area Description form for C-3B, if the present stand is left undisturbed no white pine yield is expected at harvest in the fifth period.

Area E-2

1. Yields on the national forest portion of E-2 are computed in the same manner as those for A-1 except that the time of harvest is in the fifth period.

2. On the state land in E-2 no pine will survive if no BRC work is done.

3. If BRC work is done as prescribed under "Present management" the quantity of pine on the state land is sufficient to expect a cutting at age 80 + 10. Hence, a single cut harvest at 90-year rotation is expected to yield 4,860 M of white pine in the third period.

M-1061-R1 (Rev. March 1947)

S - CONTROL
Disease - Blister Rust

Sample
WORKING UNIT ANALYSIS
YIELD COMPUTATIONS

Operation Kaniksu Working unit no. 44
Name Elk Creek
By D.J.M. Date 12/5/49

	Site	%	Net acres	Y per acre	Total yield	Total WP yield		No future BRC	Present management	High management
Area G-3A	I		X	=				All	All	All
Age now 30										
☒ NF	II	100	677	X 64	= 43,328					
☐ Other	III		X	=						
Age cut 120+10	IV		X	=				Period	Period	Period
% WP 11	→		X 43,328	=	4,766	X 0 % WP not lost =		WP 0	WP 4,766	WP
% WP lost 100						X % Loss not rec. =				
Stocking 70								Period 5	Period 5	Period
Area H-5A	I		X	=				All	All	All
Age now 160										
☒ NF	II	40	821	X 65	= 53,365					
☐ Other	III	30	616	X 45	= 27,720					
Age cut 120+10	IV	30	616	X --	= --			Period	Period	Period
% WP 80	→		X 81,085	=	64,868	X 0 % WP not lost =		WP 0	WP 64,868	WP
% WP lost 100						X % Loss not rec. =				
Stocking 75+								Period 7	Period 7	Period
Area	I		X	=				All	All	All
Age now										
☐ NF	II		X	=						
☐ Other	III		X	=						
Age cut	IV		X	=				Period	Period	Period
% WP	→		X	=		X % WP not lost =		WP	WP	WP
% WP lost						X % Loss not rec. =				
Stocking								Period	Period	Period

Area G-3A

1. All national forest land. Plans are that harvest will be made by multiple cut at age 120 + 10. The field data stipulate that no pine will survive if no BRC work is done. Under present management with BRC the area will be worked to protection standards and the 11 percent of pine is expected to reach maturity. Expected yield of white pine in the fifth period is 4,766 M.

Area H-5A

1. Residual stand to be cut in next few years. With no more BRC new stand will revert to mixed species. Hence, no white pine yield with no future BRC.

2. Under plans for "Present management" area H-5A will be rehabilitated. Portions of site quality II and III will be planted to white pine. Site IV will be planted to spruce. White pine yields obtained by multiple cut at age 120 + 10 in the seventh period will be obtained from site II and III portions and is expected to total 64,868 M.

M-1064-R1

Sample

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
YIELD SUMMARY
(Work Sheet)

Operation Kanikeu
Working unit no. 44
Name Elk Creek
By D.J.M. Date 12/5/49

Period	No BRC		Present		High	
	WP	All	WP	All	WP	All
1			5,477 5,477			
2						
3	3,929 ~~2,863~~ 6,792		15,714 4,860 20,574			
4						
5			26,795 4,765 31,551			
6			80,355 80,355			
7			56,829 64,863 121,692			
8						
9						
Totals						

Yield Summary - Work Sheet

Form M-1064-R1 has been designed as a work sheet on which yields may be summarized by periods. The period in which white pine yields will be obtained may have considerable bearing on the priority of a unit. It is important that great care be taken that the period of yield be shown correctly on the diagram, the yield computation sheet and the yield summary work sheet.

Working Unit Analysis Summary

A summary of the analysis is made on form M-1062-R1. This form, which is comprised of three sheets, was designed to meet certain requirements in the Matthews-Hutchison study and although some changes are desirable the present form will meet our current needs.

On sheet 1 is a brief statistical description of the unit which is largely self-explanatory. Following the caption "Character of net W.P. land" are listed five descriptive area classes. For the sake of consistency the following specifications should be followed in making entries:

1. Mature: Include all uncut white pine stands of age 80 + 10 and older (BRC area class 5).

2. Pole and reproduction: Include all present existing white pine stands 70 + 10 years of age and younger which are marked with a red "V" on the stand diagram. This will include all areas designated as class 1 and 2 under the BRC area classification system. Included also should be areas of class 3, 3A, or 3B which will receive protection and on which white pine yields are computed. As a general guide, pole stands include those 40 + 10 years of age and older. There may be exceptions, however.

3. Potential: This group includes all land capable of producing white pine not included in 1 and 2 above. Classes 3, 3A, 3B (except as above) 4, 4A, 5A, 5AA, and 5B compose the "potential" group.

4. Planted: White pine plantations only. Although plantations logically may be included in 2 it is desirable to segregate them because they represent a man-day investment in the unit.

The percentages in the five classes should add to 100. The distribution of area between classes should be based on the actual conditions as they exist now - not at some future date.

Following the caption "Other features" there is space for indicating the white pine producing capacity of the unit. The site index is a measure of the capacity of an area for growing white pine. A numerical index of the capacity of a unit may be derived as follows: An acre of ground of site I well stocked to 100 percent white pine will produce 83 M per acre at age 120 + 10 if multiple cut. Site II will produce 65 M per acre, site III, 45 M, and site IV, 29 M per acre. By multiplying the number of acres of each site class by the respective maximum yield obtainable and dividing this by the total acres of white pine land a figure representing the maximum average yield per acre of white pine land is obtained.

This, in effect, provides a means of rating a unit as to its ability to produce white pine volume. A point of considerable significance from the standpoint of blister rust control should be considered here. The white pine land within a given unit may have a high capacity for growing white pine. On the other hand, the white pine land may be intermingled with or surrounded by large areas of non-white pine land. The problem of rust control involves consideration of all areas within the unit. Therefore it is conceivable that although the net capacity index derived by the formula described above may be of the first magnitude, the cost of growing white pine in the unit may be prohibitive because of the work required on the non-white pine land. If in the formula we were to divide by the number of gross acres in the unit instead of the net acres of white pine land we may have an index which bears more significance. In the sample unit the net index is 58.89 and the gross index is 52.23.

Specifications covering other entries on Summary sheet 1 are as follows:

Item A,"Past effective work," is obtained from the Past BRC Cost form, M-1058-R1. The accomplishment per effective man-day varies by classes of labor. To arrive at a man-day cost of past work which is compatible with future man-day estimates certain adjustments must be made. The following adjustments were derived from a consensus among BRC men.

1 ERA man-day	= 0.8	effective man-day
1 CCC man-day 1933 and 1934	= 0.5	" "
1 CCC man-day 1935 to 1942	= 0.7	" "
1 man-day all others	= 1	" "
100 gallons Atlacide spray	= 1	" "
50 gallons ammate spray	= 1	" "
$7.50 bulldozer cost	= 1	" "

The figure for item A in the sample was derived through application of these adjustments.

Item C is the future man-day estimate taken directly from the stand diagram for present management and is the BRC man-days chargeable to first crop. Items A plus C represent the total BRC job to bring the first white pine crop through to maturity. This total divided into A and C gives the percent of total job done and to be done, respectively.

The figures shown for estimated total future BRC cost by 20-year periods were taken directly from the last column on the present management diagram.

Summary sheet 2 shows the summation of white pine yields. The figures are taken directly from the yield summary work sheet. The volume produced with BRC is obtained by subtracting the yields expected with no future BRC from yields obtained under present management.

At the bottom of the summary sheet is shown the yields that are expected from present existing stands. By subtracting the first six-period yields with no future BRC from first six-period yields under present management, the yield from present stands attributable to BRC is obtained.

On Summary sheet 3 are shown the costs of growing white pine. The past BRC costs are the adjusted man-days as described above. Other costs, such as past planting, burning, and weeding, are also shown.

The future BRC and other costs are those chargeable to first crop. The cost per M feet of white pine produced with BRC is obtained by dividing future BRC and other costs by the volume produced with BRC which appears on Summary sheet 2.

It was pointed out in the earlier pages of these specifications that the ratio of white pine yields from present existing stands against BRC and other costs in the immediate future, i.e., the first 20 years, would be used as a guide in distributing funds among the forests. On the bottom of Summary sheet 3 two ratios are shown. These are BRC plus other costs in the first 20 years against white pine yields in the first six periods and BRC costs only against this same yield.

M-1062-R1 Sample Sheet 1

S
CONTROL
Disease
Blister Rust

WORKING UNIT ANALYSIS
SUMMARY

Operation Kaniksu
By D.J.M. Date 12/5/49

☐ Inside control area
☐ Outside control area

Working unit no. 44 Name Elk Creek

DESCRIPTION:
All in NF boundary ☑ Outside NF boundary ☐ In and outside NF boundary ☐
Gross area 13,214 acres Net W.P. land 11,720 acres Percent net W.P. land 88.7%
Ownership net W.P. land: NF 7,849 acres 67% State 540 acres 5% Other 3,331 acres 28%
Character of net W.P. land: Mature 22% Pole 14% Reprod. 23% Potential 31% Planted 10%
Site I 7 % II 60 % III 28 % IV 5 % Other features WP Capacity Gross Index

Index $\frac{(798X83+7,115X65+3,191X45+616X29)}{13,214} = \frac{690,168}{13,214} = 52.23$

Net Index = $\frac{690,168}{11,720} = 58.89$

STATUS OF BLISTER RUST CONTROL

Items	Level of management			
	Present		High	
	Man-days	Dollars	Man-days	Dollars
A = Past effective work	10,174			
B = Percent of total job	30			
C = Estimated future work	23,805			
D = Percent of total job	70			
A + C = Total job	33,979			
B + D = Total percent	100	100	100	100
Estimated Total Future BRC Cost by 20-Year Periods				
1 = 1947-1966	15,453			
2 = 1967-1986	2,217			
3 = 1987-2006	1,942			
4 = 2007-2026	3,041			
5 = 2027-2046	3,415			
6 = 2047-2066	1,531			
7 = 2067-2086	1,677			
8 = 2087-2106	4,986			
9 = 2107-2126	1,321			
Totals	35,583			

Past ineffective BRC: Man-days _____ $ _____
Why ineffective _____

M-1062-R1

Sample

Sheet 2

WORKING UNIT ANALYSIS

SUMMARY

S

CONTROL

Disease

Blister Rust

Operation Kaniksu

By D J M Date 12/5/49

☐ Inside control area

☐ Outside control area

Working unit no. 44 Name Elk Creek

YIELD

20-year periods		Level of management					
		No future BRC		Present		High	
		White pine	All species	White pine	All species	White pine	All species
		M	M	M	M	M	M
1	1947-1966			5,477			
2	1967-1986						
3	1987-2006	6,792		20,574			
4	2007-2026						
5	2027-2046			31,551			
6	2047-2066			80,355			
7	2067-2086			121,692			
8	2087-2106						
9	2107-2126						
Total		6,792		259,649			
Volume produced with BRC				252,857			

The entries in this table are based on the estimated yield or cut (but not on the growth) in each of seven 20-year periods under the assumed conditions.

First six-period yield	present management	137,957
" " " "	no future BRC	6,792
" " " "	due BRC	131,165

M-1062-R1

Sample

Sheet 3

WORKING UNIT ANALYSIS
SUMMARY

S
CONTROL
Disease
Blister Rust

Operation Kaniksu
By D.J.M. Date 12/13/49

☐ Inside control area
☐ Outside control area

Working unit no. 44 Name Elk Creek

SPECIAL COSTS OF GROWING WHITE PINE

Kind of costs	Level of management			
	Present		High	
	Man-days	Dollars	Man-days	Dollars
Past costs - BRC	10,174			
Other	2,396			
Total	12,570			
Future costs - BRC	23,805			
Other	8,480			
Total	32,285			
	WP - M	All - M	WP - M	All - M
Total yield produced with BRC	252,857			

Future Cost Per M Feet of White Pine Produced With BRC

	md	$			md	$		
Kind of cost - BRC	0.094		xxxx	xxxx			xxxx	xxxx
Other	0.034		xxxx	xxxx			xxxx	xxxx
Total	0.128		xxxx	xxxx			xxxx	xxxx

A. First six-period yield present management due BRC — 131,165 M
B. Future BRC cost, first 20-year period — 15,453 man-days
C. Future "other costs," first 20-year period — 8,480 man-days

$$\text{R.O. Index } \frac{B + C}{A} = \frac{15,453 + 8,480}{131,165} = \frac{23,933}{131,165} = 0.182$$

$$\text{R.O. Index } \frac{B}{A} = \frac{15,453}{131,165} = 0.118$$

APPENDIX

BRC Area Classification

A numerical system of classifying timber types in the white pine belt of the Northwestern Region was developed in 1943 by the Bureau of Entomology and Plant Quarantine.* This classification was based upon the white pine producing qualities of an area and the feasibility of establishing protection from blister rust. This system has been adopted for use in the working unit analysis.

In the years succeeding its inception some modification in the interpretation of certain class designations has occurred.**

Following is a description of the BRC area classes:

Class 1: Areas predominantly well stocked with thrifty white pine of reproduction or pole size which can be protected from blister rust at reasonable cost. Class 1 areas are expected to produce 20,000 board feet or more per acre (130-year rotation with intermediate cuttings).

Class 2: Areas sufficiently stocked with thrifty white pine reproduction or pole which warrant the cost of protection. Class 2 areas are expected to produce 10,000 to 20,000 board feet per acre and would be included in all work programs.

Class 3: Potential white pine areas at present not supporting adequate white pine stocking or adequate source of white pine seed. Essentially these areas are open and currently understocked to all species. Under their present condition class 3 areas would not warrant blister rust control but are held in deferred status to allow for the possibility of natural reseeding or planting to white pine before other species seed the openings.

Class 3A: Areas of reproduction or pole not supporting sufficient white pine to meet class 1 and 2 standards but will produce between 5,000 and 10,000 board feet of white pine per acre. On these areas growth of other species has eliminated further establishment of white pine through planting or natural seeding. Class 3A, like class 3, was set up to provide for the lower priority areas of low ribes population and low infection. 3A areas may not warrant protection for themselves alone. They will, however, contribute considerable white pine volume to the total of the working unit when they are worked to protection standards as a result of being intermingled with or adjacent to classes 1 and 2.

Class 3B: Reproduction or pole stands understocked to white pine on which the growth of other species precludes the further establishment of white pine. Class 3B areas are expected to produce less than 5,000 board feet of white pine per acre and do not warrant blister rust control.

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* White Pine Blister Rust Control in the Northwestern Region, January 1 to December 31, 1943 (Annual Report BE & PQ).

**Northwestern Region Stocking - Rust Damage Survey Manual 1949 (BE & PQ), and Clarification of Some Points Having to do With the Application of Stocking-Blister Rust Damage Survey Data to Unit Area Analysis (R.T. Bingham, October 1948).

Class 4: Areas comparable with classes 1 and 2 in stocking and composition but with difficult ribes eradication working conditions (high cost of control) which make blister rust control unfeasible. Class 4 also includes areas originally comparable with classes 1 and 2 not covered by recent stocking-rust damage survey which have suffered an apparently large but unknown amount of damage by rust. Such areas are subject to reclassification after survey.

Class 4A: Areas of reproduction and pole comparable with classes 1 and 2 originally but where the white pine stocking is known to be reduced by rust to a point where blister rust control is not warranted. Class 4A may be comparable with classes 3B and may be treated as such. The designation 4A signifies that the low white pine stocking is a result of rust damage rather than accident of seeding.

Class 5: Uncut mature stands 80 years or older on white pine lands.

Class 5A: Cut-over areas in white pine type supporting a heavy residual stand of other species. Establishment of white pine would require rehabilitation.

Class 5AA: White pine cut-over areas supporting little or no residual stand but which have definite possibilities of reproducing to white pine.

Class 5B: Cut-over areas which are not likely to be reconverted to white pine although they may be ecologically suitable. Class 5B areas may often be of relatively poor site quality and, because of the presence of adequate seed source of other species and the character of the surrounding area, it may be economically more feasible to convert to species other than white pine.

Class 6: Areas not ecologically suitable for white pine or of very poor site quality: high elevation, rocky, nonoperable, etc.

Rates for Cost Estimates

Following is a table of rates for cost estimates prepared for use in working unit analyses. The BRC rates by age and type of stand need not be applied arbitrarily, but rather are to be used as guides in making estimates in each specific case. They represent the best judgment of experienced men. Most of the other rates will be applied uniformly throughout the area for which they are made.

The costs of other operations such as burning, planting and weeding were obtained by conferences with various experts. Crocker, DeJarnette, Lyman and others were consulted in setting up the man-day costs of prescribed burning. DeJarnette was consulted on planting costs, and Wellner helped in estimating the costs of weeding.

RATES FOR COST ESTIMATES

Man-Days Per Acre Included in Work Unit

Symbol	Description of conditions and treatments	BRC cost by forests						Other costs all forests		
		Clearwater	St. Joe	Coeur d'Alene	Kaniksu	Cabinet	Kootenai	Burning	Planting	Weeding
M	Maintenance cost per acre per 20-year period.	0.1	0.1	0.1	0.1	0.1	0.1			Weeding in stands up to 10 years at same rate.
XX	Multiple cut in WP stands to devitalize ribes and restock to WP naturally. Low ribes potential.	0.2	0.2	0.2	0.2	0.2	0.2			
XC	Multiple cut in present stands with high ribes potential, over 60 percent WP and cut to promote ribes devitalization and restock to WP naturally.	0.4	0.4	0.4	0.4	0.4	0.4			
XW	Multiple cut as above in well- or medium-stocked stands with 25 to 59 percent WP. Weeded to increase composition to more than 70 percent WP.	0.4	0.4	0.4	0.4	0.4	0.4			2.0
CP	Clear cutting or residual salvage followed by prescribed burning and planting. Mostly double burns.	0.8	0.8	0.8	0.8	0.8	0.8	1.3	2.0	
RP	Reburn of single burn for ribes and hazard reduction and preparation for planting followed by planting.	1.5	1.5	1.5	1.5	1.5	1.5	1.0	2.0	

Man-days per acre per 20-year period in a circle.

Symbol	Description of conditions and treatments	BRC cost by forests						Other costs all forests		
		Clearwater	St. Joe	Coeur d'Alene	Kaniksu	Cabinet	Kootenai	Burning	Planting	Weeding
MD A	Mixed YP-DF-LPP type cut-over and reproduction worked to protect adjacent stands.	1.5	1.25	1.5	1.0	0.3	0.3			
	WP type (or WF-C-L) cut-over and reproduction worked to protect adjacent stands of reproduction 0-80 years old.	3.0	3.0	3.0	2.5	2.0	2.0			
	WP type, cut-over or natural reproduction, worked to protect itself. (General coverage and mop-up.)	3.0	3.0	3.0	2.5	2.0	2.0			
	WP type on other than national forest land with WP cut at 90 years and worked to protect adjacent stands.	1.5	1.25	1.25	1.25	1.0	1.0			
	WP type on other than national forest land with WP cut at 90 years and worked to protect adjacent stands after mixed is cut at rotation age.	2.0	2.0	2.0	2.0	2.0	2.0			
	High elevation types including subalpine worked to protect adjacent WP stands.	3.0	3.0	4.0	4.0	4.0	4.0			

Revised 1-12-49

Yield Tables

Tables to be used for estimating future yields in the BRC working unit analysis were prepared by Russell K. LeBarron and Charles A. Wellner. The original set was used mainly for the Matthews-Hutchison study and was prepared in terms of four broad stocking classes, poor, medium, good, and planted, which corresponded to the stocking data that were available at the time of the study. The need for a much finer break-down by stocking classes became apparent after the intensive stocking surveys were begun in 1948. The tables were revised by Wellner and now provide for yield estimates in steps of 10 percent stocking classes.

Stocking surveys in plantations show a variety of degrees of stocking so it appears best to use the revised tables as given for both planted and natural stands. Otherwise the two sets of tables are basically the same.

The revised tables will be used in estimating yields on all areas covered by stocking surveys. The original set of tables is included here also since there may be occasion to estimate yields on areas not yet covered by surveys.

Following are quotations from a memorandum dated February 14, 1947, to A. G. Lindh from Charles L. Tebbe, by Russell K. LeBarron, Acting, designated RS-NRM-MENSURATION-Stand and Tree Studies.

The tables giving growth predictions for variously stocked stands of white pine of different ages have been prepared. They are attached.

The recommendations made by Matthews and Hutchison concerning rotation ages, levels of practice, log rule, etc., have been followed.

The yields as predicted include all trees 7.6 inches d.b.h. and over. The decision to lower the utilization standard to this level is based upon the increasingly close utilization of young second-growth timber. The low standard has the effect of materially increasing the yield at 60 to 80 years, but it exerts comparatively little effect upon yield at 120 years. For example, on site index 60, the yields of normally stocked stands are as follows:

Age	7.6" and over feet BM Scribner	12.6" and over feet BM Scribner
60	13,100	3,700
80	32,800	17,900
120	68,700	59,000

The methods by which the growth predictions were obtained are described below:

1. The normal yield table (I.T. Haig, Second-Growth Yield for the Western White Pine Type, U.S.D.A. Tech. Bull. 323) was used as the foundation.

2. It was assumed that well-stocked stands could not be expected to attain the ideal full stocking of normal stands on the average. Hence, a ceiling of 75 percent of normal was assigned to "well-stocked" stands. This correction has

no relation to nonstocked areas such as large rock slides, and stream bottoms which are excluded in type mapping. It is an additional correction to account for poor distribution and other adverse accidents of nature. Admittedly, the size of the correction is a guess. However, we know that it corrects in the right direction.

In the case of plantations, the ceiling for maximum stocking was set at 85 percent. It was reasoned that plantations are likely to do a little better than natural stands because of the better distribution of the trees.

3. Cull and breakage factors of 5 percent for stands up to 80 years, 7 percent for stands 81 to 120 years, and 10 percent for stands 121 years or more in age were deducted from all gross yields.

4. Stocking. The stocking classes of good, medium, and poor are equivalent to the Forest Survey stocking classes used in the white pine type. For all ages of seedling, sapling and pole stands for all sites, the classes are equivalent to the following percentages of normal in terms of basal area: Poor = 25 percent, medium = 45 percent, good = 75 percent. Gehrhardt's formula was used for estimating the approach to normality of understocked stands. A preliminary check of the application of this formula to some actual plot records gave good results. Application of Gehrhardt's formula to the Forest Survey stocking standards required some detailed calculations of basal area stocking for stands of various ages and densities. The most significant feature brought out by these calculations is that younger stands of a given degree of understocking will produce greater yields than older stands of the same degree of understocking. For example: A 10-year-old "poorly stocked" stand will become 61 percent stocked when it reaches 60 years, but a 30-year-old "poorly stocked" stand will be only 35 percent stocked at 60 years. The adjustments "make sense."

Stocking in terms of other standards must be converted to Forest Survey standards before using the tables.

5. Cutting practices. A system of shelterwood cuttings was set up for estimating yield under the better level of management. The chief cuts were removal of 60 percent of the volume at 120 years and the remainder at 140 years (130 and 150 years when taking into account the 10-year allowance for delay in restocking). In addition to the two principal harvest cuttings, a series of preliminary preparation cuttings were provided. The first preparation cutting was made when the stand had reached a volume that allowed removal of approximately 2,000 board feet per acre.

Subsequent preparation cuttings were made at 20-year intervals until 120 years was reached. Of course, in some cases the interval between the last preparation cutting and age 120 was only 10 years. In such instances, a proportionately lighter cut was made.

The basis for estimating the allowable volume to remove in the preparation cuts was partly the capture of anticipated natural mortality, and partly anticipated increase in growth due to thinning.

The mortality on several well-stocked growth plots in the white pine type averages three-fourths of 1 percent a year, or about 15 percent in 20 years. It should be possible to recover a considerable part of this expected mortality on 20-year improvement cuttings.

In addition net growth should be slightly increased by conservative thinnings. We assumed that 1 percent per year (20 percent in 20 years) can be harvested without hindering the growth of stands at the natural rates. Thus, if a well-stocked stand contained 10,000 board feet at age 60 years, a cut of 2,000 board feet was assigned. Similarly, at 80 years, if the same stand was found to have grown to 25,000 board feet, a second cut, 5,000 board feet was taken.

In understocked stands, relatively light cuts were made on the assumption that such stands have less than normal mortality and less need for thinning. A factor of three-fourths of 1 percent was used for measuring cuts for medium-stocked stands, and one-half of 1 percent for poorly-stocked stands. In no case was the initial cut made until 2,000 board feet per acre could be removed.

It was estimated that the residual 40 percent stand left after the major harvest cutting at 120 years would increase in volume by 20 percent during the following 20 years.

6. Calculated yields for medium and poor stocking classes were curved by site classes to eliminate out-of-line values and to estimate yields for certain age classes. Final yields for these stocking classes were read from these curves.

7. Rotations of 90 and 130 years are used. Ten years are allowed for delay in restocking. Hence, yields are calculated on normal yields at 80 and 120 years.

The complete calculation for a well-stocked stand, site index 40, is shown below to illustrate the main features of the system.

90 years - yield table - 16,800 (item 1 in text)	
Less 25% (item 2 in text)	
Less 7% (item 3 in text)	
Net - 69.8% = 11,726	
Harvest 20% (item 5 in text)	2,300
110 years - yield table - 28,300	
Net 69.8% = 19,753	
Harvest 10% (item 5 in text)	2,000
120 years - yield table - 33,100	
Net - 69.8% = 23,104	
Harvest 60% (item 5 in text)	13,800
140 years - residual - 9,304	
Grow 20% = 1,860	
Cut all (item 5 in text)	11,200
Total yield	29,300

The final predictions are based partly upon established facts and partly upon assumptions. However, no assumptions were made without carefully considering and weighing the related factors. The predictions, therefore, are not hastily considered guesses. We do not know whether or not they are too high, too low, or if the trends are right, but they represent our best efforts with the tools at hand. As a matter of fact, we rather welcomed the opportunity to dig into this problem. Similar questions have been asked time and again, and we had no answers ready...

The tables referred to in this memorandum follow:

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE, 130-YEAR ROTATION WITH INTERMEDIATE CUTTINGS

Site	Present stocking	Yield in board feet, Scribner, 7.6" d.b.h. and over, by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
				Board feet			
I 70	Planted	94,100	94,100	94,100	94,100	94,100	83,100
	Good	82,900	82,900	82,900	82,900	82,900	73,400
	Medium	80,700	80,000	73,000	67,200	66,700	58,700
	Poor	65,800	62,800	49,700	41,100	39,500	37,300
II 60	Planted	74,000	74,000	74,000	74,000	74,000	63,600
	Good	65,400	65,400	65,400	65,400	65,400	56,100
	Medium	64,600	63,800	57,700	53,200	52,500	49,600
	Poor	52,200	50,000	39,400	32,200	31,000	31,000
III 50	Planted	51,100	51,100	51,100	51,100	51,100	48,000
	Good	45,200	45,200	45,200	45,200	45,200	42,400
	Medium	44,500	43,700	39,600	36,900	36,700	34,200
	Poor	36,000	34,300	26,900	21,800	20,900	20,900
IV 40	Planted	33,100	33,100	33,100	33,100	33,100	30,400
	Good	29,300	29,300	29,300	29,300	29,300	27,000
	Medium	29,300	28,600	25,400	24,300	23,600	23,600
	Poor	23,100	22,100	17,300	14,300	14,000	14,000

Method of Construction

1. Foundation: U.S.D.A. Tech. Bull. 323.

2. A stocking ceiling of 75 percent of normal assigned to well-stocked natural stands and 85 percent of normal to planted stands

3. Cull and breakage deductions from all gross yields:

   5 percent for stands up to 80 years
   7 percent for stands 81 to 120 years
   10 percent for stands 121 years and over

4. Stocking classes are Forest Survey stocking classes used in the white pine type. Gehrhardt's formula (K factor of .8) used for estimating approach of understocked stands to normality.

5. A system of shelterwood cuttings was used as follows: (a) 60 percent of volume at 120 years; (b) remainder of volume at 140 years. Growth of 1 percent per year allowed; (c) preliminary cuts at 20-year intervals when the stand would allow a cut of 2,000 or more board feet. Intermediate cuts set at 20 percent for well-stocked and planted stands, 15 percent for medium-stocked and 10 percent for poorly-stocked stands.

6. Calculated yields for medium and poor stocking classes curved by site classes.

7. Rotation of 130 years used with a 10-year allowance for restocking.

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE, 90-YEAR ROTATION, SINGLE CUT

Site	Present stocking	Yield in board feet, Scribner, 7.6" d.b.h. and over by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
				Board feet			
I	Planted	37,500	37,500	37,500	37,500	37,500	37,500
70	Good	33,200	33,200	33,200	33,200	33,200	33,200
	Medium	33,200	32,600	30,000	27,700	27,300	27,300
	Poor	28,300	27,800	21,700	17,800	17,200	17,200
II	Planted	26,500	26,500	26,500	26,500	26,500	26,500
60	Good	23,400	23,400	23,400	23,400	23,400	23,400
	Medium	23,400	23,200	21,200	19,700	19,300	19,300
	Poor	19,900	19,200	15,300	12,600	12,100	12,100
III	Planted	15,700	15,700	15,700	15,700	15,700	15,700
50	Good	13,900	13,900	13,900	13,900	13,900	13,900
	Medium	13,900	13,800	12,600	11,500	11,400	11,400
	Poor	11,900	11,500	9,100	7,600	7,200	7,200
IV	Planted	9,100	9,100	9,100	9,100	9,100	9,100
40	Good	8,100	8,100	8,100	8,100	8,100	8,100
	Medium	8,100	8,000	7,300	6,700	6,600	6,600
	Poor	6,900	6,600	5,300	4,300	4,100	4,100

Method of Construction

1. Foundation: U.S.D.A. Tech. Bull. 323

2. A stocking ceiling of 75 percent of normal assigned to well-stocked natural stands and 85 percent of normal to planted stands.

3. A 5 percent cull and breakage deduction from all gross yields.

4. Stocking classes are Forest Survey stocking classes used in the white pine type. Gehrhardt's formula (K factor of .8) used for estimating approach of understocked stands to normality.

5. Calculated yields for medium and poor stocking classes curved by site classes.

6. Rotation of 90 years used with a 10-year allowance for restocking.

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE, 130-YEAR ROTATION, SINGLE CUT

Site	Present stocking	Yield in board feet, Scribner, 7.6" d.b.h. and over by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
				Board feet			
I 70	Planted	66,900	66,900	66,900	66,900	66,900	66,900
	Good	59,100	59,100	59,100	59,100	59,100	59,100
	Medium	59,100	59,100	55,100	51,200	51,200	51,200
	Poor	53,500	53,500	41,000	33,100	33,100	33,100
II 60	Planted	54,300	54,300	54,300	54,300	54,300	54,300
	Good	48,000	48,000	48,000	48,000	48,000	48,000
	Medium	48,000	48,000	44,700	41,500	41,500	41,500
	Poor	43,400	43,400	33,300	26,900	26,900	26,900
III 50	Planted	39,100	39,100	39,100	39,100	39,100	39,100
	Good	34,600	34,600	34,600	34,600	34,600	34,600
	Medium	34,600	34,600	32,200	29,900	29,900	29,900
	Poor	31,300	31,300	24,000	19,400	19,400	19,400
IV 40	Planted	26,100	26,100	26,100	26,100	26,100	26,100
	Good	23,100	23,100	23,100	23,100	23,100	23,100
	Medium	23,100	23,100	21,500	20,000	20,000	20,000
	Poor	20,900	20,900	16,000	12,900	12,900	12,900

Method of Construction

1. Foundation: U.S.D.A. Tech. Bull 323.
2. A stocking ceiling of 75 percent of normal assigned to well-stocked natural stands and 85 percent of normal to planted stands.
3. Cull and breakage deductions from all gross yields:

   5 percent for stands up to 80 years
   7 percent for stands 81 to 120 years
   10 percent for stands 121 years and over

4. Stocking classes are Forest Survey stocking classes used in the white pine type. Gehrhardt's formula (K factor of .8) used for estimating approach of understocked stands to normality.
5. Calculated yields for medium and poor stocking classes curved by site classes.
6. Rotation of 130 years used with a 10-year allowance for restocking.

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE
130-YEAR ROTATION WITH INTERMEDIATE CUTTINGS
(Table of 2-14-47 Curved)

Site	Present stocking	Yield in board feet, Scribner, 7.6 inches d.b.h. and over by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
	10	41,000	37,000	25,000	16,000	14,000	12,000
I	20	59,000	55,000	43,000	34,000	31,000	30,000
	30	72,000	69,000	58,000	50,000	47,000	44,000
70	40	79,000	77,000	69,000	62,000	59,000	55,000
	50	82,000	81,000	76,000	71,000	67,000	62,000
	60	83,000	83,000	79,000	77,000	73,000	68,000
	70	83,000	83,000	82,000	81,000	78,000	72,000
	75+	83,000	83,000	83,000	83,000	79,000	73,000
	10	28,000	25,000	19,000	12,000	10,000	10,000
II	20	45,000	43,000	33,000	26,000	24,000	24,000
	30	57,000	55,000	45,000	38,000	37,000	37,000
60	40	63,000	62,000	54,000	49,000	48,000	46,000
	50	65,000	65,000	61,000	57,000	56,000	52,000
	60	65,000	65,000	64,000	62,000	61,000	54,000
	70	65,000	65,000	65,000	64,000	64,000	56,000
	75+	65,000	65,000	65,000	65,000	65,000	56,000
	10	17,000	15,000	10,000	8,000	6,000	6,000
III	20	31,000	29,000	22,000	19,000	16,000	15,000
	30	40,000	38,000	31,000	28,000	25,000	24,000
50	40	44,000	43,000	37,000	34,000	33,000	31,000
	50	45,000	44,000	41,000	39,000	38,000	37,000
	60	45,000	45,000	43,000	43,000	42,000	40,000
	70	45,000	45,000	45,000	45,000	44,000	42,000
	75+	45,000	45,000	45,000	45,000	45,000	42,000
	10	10,000	9,000	7,000	5,000	4,000	4,000
IV	20	19,000	18,000	14,000	11,000	11,000	11,000
	30	26,000	25,000	20,000	17,000	17,000	17,000
40	40	29,000	28,000	24,000	23,000	22,000	22,000
	50	29,000	29,000	26,000	26,000	25,000	25,000
	60	29,000	29,000	28,000	28,000	27,000	26,000
	70	29,000	29,000	29,000	29,000	29,000	27,000
	75+	29,000	29,000	29,000	29,000	29,000	27,000

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE
90-YEAR ROTATIONS, SINGLE CUT
(Table of 2-14-47 Curved)

Site	Present stocking	Yield in board feet, Scribner, 7.6 inches d.b.h. and over by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
	10	18,000	17,000	11,000	8,000	7,000	7,000
I	20	26,000	25,000	18,000	15,000	14,000	14,000
	30	30,000	30,000	24,000	21,000	20,000	20,000
70	40	33,000	32,000	29,000	26,000	25,000	25,000
	50	33,000	33,000	31,000	29,000	29,000	29,000
	60	33,000	33,000	32,000	31,000	31,000	31,000
	70	33,000	33,000	33,000	33,000	32,000	32,000
	75+	33,000	33,000	33,000	33,000	33,000	33,000
	10	11,000	10,000	6,000	4,000	3,000	3,000
II	20	18,000	17,000	13,000	10,000	9,000	9,000
	30	21,000	21,000	17,000	15,000	14,000	14,000
60	40	23,000	23,000	20,000	18,000	18,000	18,000
	50	23,000	23,000	22,000	21,000	20,000	20,000
	60	23,000	23,000	23,000	22,000	22,000	22,000
	70	23,000	23,000	23,000	23,000	23,000	23,000
	75+	23,000	23,000	23,000	23,000	23,000	23,000
	10	7,000	6,000	4,000	3,000	2,000	2,000
III	20	11,000	10,000	8,000	6,000	6,000	6,000
	30	13,000	12,000	10,000	9,000	8,000	8,000
50	40	14,000	13,000	12,000	11,000	10,000	10,000
	50	14,000	14,000	13,000	12,000	12,000	12,000
	60	14,000	14,000	14,000	13,000	13,000	13,000
	70	14,000	14,000	14,000	14,000	14,000	14,000
	75+	14,000	14,000	14,000	14,000	14,000	14,000
	10	4,000	3,000	2,000	1,000	1,000	1,000
IV	20	6,000	6,000	4,000	3,000	3,000	3,000
	30	7,000	7,000	6,000	5,000	5,000	5,000
40	40	8,000	8,000	7,000	6,000	6,000	6,000
	50	8,000	8,000	8,000	7,000	7,000	7,000
	60	8,000	8,000	8,000	8,000	8,000	8,000
	70	8,000	8,000	8,000	8,000	8,000	8,000
	75+	8,000	8,000	8,000	8,000	8,000	8,000

EMPIRICAL YIELD TABLE FOR STANDS OF THE WESTERN WHITE PINE TYPE
130-YEAR ROTATION, SINGLE CUT
(Table of 2-14-47 Curved)

Site	Present stocking	Yield in board feet, Scribner, 7.6 inches d.b.h. and over by present age classes					
		5 or under	10	20	30 or 40	50 or 60	70 plus
	10	37,000	37,000	25,000	16,000	16,000	16,000
I	20	49,000	49,000	36,000	28,000	28,000	28,000
	30	56,000	56,000	46,000	38,000	38,000	38,000
70	40	58,000	58,000	53,000	47,000	47,000	47,000
	50	59,000	59,000	57,000	54,000	54,000	54,000
	60	59,000	59,000	59,000	57,000	57,000	57,000
	70	59,000	59,000	59,000	59,000	59,000	59,000
	75+	59,000	59,000	59,000	59,000	59,000	59,000
	10	32,000	32,000	18,000	11,000	11,000	11,000
II	20	41,000	41,000	29,000	22,000	22,000	22,000
	30	45,000	45,000	37,000	31,000	31,000	31,000
60	40	47,000	47,000	43,000	39,000	39,000	39,000
	50	48,000	48,000	46,000	44,000	44,000	44,000
	60	48,000	48,000	47,000	46,000	46,000	46,000
	70	48,000	48,000	48,000	48,000	48,000	48,000
	75+	48,000	48,000	48,000	48,000	48,000	48,000
	10	22,000	22,000	14,000	8,000	8,000	8,000
III	20	29,000	29,000	21,000	16,000	16,000	16,000
	30	33,000	33,000	27,000	23,000	23,000	23,000
50	40	34,000	34,000	31,000	28,000	28,000	28,000
	50	35,000	35,000	33,000	31,000	31,000	31,000
	60	35,000	35,000	34,000	33,000	33,000	33,000
	70	35,000	35,000	34,000	34,000	34,000	34,000
	75+	35,000	35,000	34,000	34,000	34,000	34,000
	10	13,000	13,000	8,000	5,000	5,000	5,000
IV	20	19,000	19,000	14,000	10,000	10,000	10,000
	30	22,000	22,000	18,000	15,000	15,000	15,000
40	40	23,000	23,000	21,000	19,000	19,000	19,000
	50	23,000	23,000	22,000	21,000	21,000	21,000
	60	23,000	23,000	23,000	22,000	22,000	22,000
	70	23,000	23,000	23,000	23,000	23,000	23,000
	75+	23,000	23,000	23,000	23,000	23,000	23,000

Estimates of Yields of Mixed Species

In the specifications of unit analysis described in the foregoing pages of this text we were concerned with estimates of white pine volumes only. However, it may be desirable in specific cases to estimate yields of other species growing on white pine lands.

Two factors complicate this process. (1) It is recognized that in general mixed species do not produce the same volume at maturity as white pine for a given site quality and stand density. Grand fir generally will produce as much and sometimes more volume than white pine while lodgepole pine, on the other hand, will produce a considerably less volume. (2) In a white pine reproduction or pole stand where control of blister rust is not accomplished the associated mixed species take over as the pine succumbs to the rust. As the pine dies out the mixed species take over some or all of the space formerly occupied by the white pine stems. The extent to which this space is utilized by mixed species depends upon the composition and age of the stand at the time the damage begins and upon the percent of the white pine that is killed. This change in composition complicates the process of estimating future yields of the stand.

Wellner has prepared a table for use in estimating yields of mixed species in which are shown the percentages by which the yield table figures are to be reduced when applying them to mixed species. The species normally associated with white pine are divided into four groups, the species in each group having similar growth characteristics. Not only does the volume growth vary by groups but also by the proportion of pine with which they are associated.

For use in the Matthews-Hutchison study, Wellner and Matthews prepared a table which shows the percent of white pine loss that is not recovered by other species when blister rust removes portions of the original white pine stocking.

A set of these tables is included herein.

Following these tables is a sample yield calculation describing the method of estimating future yields of mixed species and illustrating the use of the tables.

ESTIMATED CORRECTION OF YIELDS IN THE WESTERN WHITE PINE TYPE
FOR STAND COMPOSITION

Percent of stand white pine	Reduce yield of mixed species by indicated percent when remainder of stand is predominately			
	Grand fir	Larch-Douglas fir-Engelmann spruce	Western hemlock, western redcedar	Lodgepole pine
0	0	23	34	55
10	0	20	30	50
20	0	18	27	45
30	0	15	23	40
40	0	12	19	35
50	0	10	15	30
60	0	9	13	25
70	0	7	10	20
80	0	5	8	15
90	0	3	5	10
100	0	0	0	0

Table prepared by Wellner and Matthews to be used in the yield computations to estimate:

PERCENT OF WHITE PINE LOSS NOT
RECOVERED BY OTHER SPECIES

Percent white pine	Percent of loss at maturity	Present age			
		0 - 20	30 - 50	60 - 80	Over 80
0 - 25	0 - 25	0	25	70	100
	26 - 50	0	30	70	100
	51 - 75	10	35	75	100
	76 - 100	10	40	75	100
26 - 50	0 - 25	0	30	75	100
	26 - 50	10	35	75	100
	51 - 75	10	40	80	100
	76 - 100	20	50	80	100
51 - 75	0 - 25	0	35	75	100
	26 - 50	10	40	80	100
	51 - 75	20	50	80	100
	76 - 100	30	60	85	100
76 - 100	0 - 25	0	40	80	100
	26 - 50	20	50	80	100
	51 - 75	40	60	90	100
	76 - 100	50	70	90	100

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Sample - Yields of mixed species

WORKING UNIT ANALYSIS

YIELD COMPUTATIONS

Operation Kaniksu Working unit no. 44

Name Elk Creek

By D.J.M. Date 10/12/50

S = CONTROL

Disease = Blister Rust

	Site	%	Net acres	Y per acre	Total yield	Total WP yield	No future BRC	Present management	High management
Area B-2	I		X		=	Present Management (With BRC)	All	All	All
Age now 60						49,105		28,382	
☑ NF	II	100	805 X 61		= 49,105	-15,714		+15,714	
☐ Other	III		X		=	33,391 →	33,391	44,096	
Age cut 120+10	IV		X		=	Yield of mixed at WP growth rate	x 0.85 → 28,382 Actual yield of mixed	Total actual yield all species	
							Period	Period 3	Period
% WP 32 →				X 49,105	=	15,714 X 100% WP not lost =	WP	WP	WP P
% WP lost --								15,714	
Stocking 60						X % Loss not rec. =	Period	Period 3	Period
Area B-2	I		X		=	No Future BRC	All	All	All
Age now 60						39,677	28,598		
☑ NF	II	100	805 X 61		= 49,105	- 3,929	+3,929		
☐ Other	III		X		=	35,748 →	32,527		
Age cut 120+10	IV		X		=	Yield of mixed at WP growth rate	x 0.80 → 28,598 Actual yield of mixed	Total actual yield all species	
							Period 3	Period	Period
% WP 32 →				X 49,105	=	15,714 X 25% WP not lost =	WP	WP	WP
% WP lost 75				-9,428		-3,929	3,929		
Stocking 60	Yield of all species at WP growth rate →			39,677		11,785 X 80% Loss not rec.			
				WP lost →		= → 9,428	Period 3	Period	Period
Area	I		X		=		All	All	All
Age now	II		X		=				
☐ NF	III		X		=				
☐ Other	IV		X		=		Period	Period	Period
Age cut									
% WP →				X	=	X % WP not lost =	WP	WP	WP
% WP lost									
Stocking						X % Loss not rec. =	Period	Period	Period

Sample Calculation of Yields of Mixed Species

1. The national forest portion of area B-2 in the sample unit has been selected for illustration. From area description B-2 supports a 60-year-old pole stand 32 percent white pine with a stocking density 60 percent normal. The national forest portion involves 805 acres all site II. Associated species are predominantly larch, Douglas-fir and spruce.

2. Consider the stand first under present management with blister rust control. The yield table for 130-year rotation with intermediate cuttings shows an expected yield on B-2 of 61 M per acre or 49,105 M board feet total for the 805 acres. The stand being 32 percent white pine a yield of 15,714 M board feet of white pine can be expected in the third period under present management.

3. Now in making yield calculations for mixed species it must be remembered that the figures in the yield tables prepared by LeBarron and Wellner are based on white pine growth rate. If we subtract the 15,714 M of white pine from the 49,105 M total as is shown in the sample, the 33,391 M board feet remaining would represent the volume of mixed only if it were true that mixed species produce board foot volume at the same rate as white pine.

4. Refer now to Wellner's correction table. This table shows that for a stand with 30 percent white pine and with associated mixed species predominantly larch, Douglas-fir and spruce the yield figure for mixed should be reduced by 15 percent. Thus 33,391 x 0.85 or 28,382 M board feet is the actual volume of mixed expected from the 805 acres of B-2. This 28,382 M of mixed plus the 15,714 M of white pine is the expected yield of all species to be cut in the third period from the national forest portion of B-2 under present management.

5. Consider next what will happen if no further BRC work is done. The area description sheet for B-2 indicates that 75 percent of the potential white pine volume will be lost due to blister rust. Thus of the 15,714 M board feet of white pine normally expected from this area only 25 percent or 3,929 M will be available for harvest at maturity in the third period under no future BRC conditions. 15,714 M minus this 3,929 M or 11,785 M is the potential white pine volume lost through the action of the rust.

6. Before calculating the expected volume of mixed under no future BRC conditions, let us consider what actually happens to the stand. As the white pine trees die out the mixed species gradually take over some of the space formerly occupied by these white pine stems. The extent to which this space is utilized by other species depends upon the age of the stand when damage occurs, the percentage of white pine that was present, and the percent of the white pine crop trees that are destroyed by the rust. The amount of this space recovered by other species may vary from 100 percent in a very young stand to practically none in a stand approaching maturity at the time of damage.

7. The loss of the white pine in that portion of the space not recovered by other species is definitely a direct loss to the ultimate volume of the stand. In this example let us assume for the moment that all species produce volume at the white pine rate. Under this assumption if the mixed species were to take over all the space formerly occupied by white pine the volume recovery would be complete and the expected yield of all species would be 49,105 M shown in the sample.

8. Referring now to the Wellner and Matthews table immediately preceding this example we find that for a stand such as B-2 which at 60 years of age contains from 26 to 50 percent white pine of which a 51 to 75 percent loss from rust is expected, 80 percent of the white pine loss is not recovered by other species. Eighty percent of the white pine loss, that is, 80 percent of the 11,784 M, or 9,428 M, therefore, represents the net loss to the stand due to rust. Thus 49,105 M minus 9,428 M or 39,677 M would be the total volume of the stand at maturity if all species produced volume at the white pine rate.

9. The 39,677 M represent the expected volume of all species including the 3,929 M of white pine which is about 10 percent. 39,677 M minus the 3,929 M or 35,748 M (90 percent) would be the yield volume of mixed timber under the above assumption.

10. Referring again to the correction table we find that in a stand under these conditions with 10 percent white pine and 90 percent mixed predominantly larch, Douglas-fir and spruce, the yield figure of the mixed should be reduced by 20 percent. Thus 35,748 x 0.80 or 25,598 M board feet would be the actual yield of mixed expected from the 805 acres. 28,598 M of mixed plus 3,929 M white pine or 32,527 M board feet total is the estimated yield of all species to be harvested in the third period from the national forest portion of B-2 if no more BRC work is done.